Chapter 3

Transportation
Design Standards and Policies
Revised December 1999

Chapter 3, Transportation, describes the geometric requirements for each street classification defined by the Circulation Element of the General Plan. This chapter also presents the criteria and procedures to be used when preparing traffic signal plans and traffic signing and pavement marking design in the City of Scottsdale. Transit facility and bikeway design guidelines are also presented in this chapter. Chapter 3 also contains guidelines for the design of the structural section of flexible pavements, which are to be constructed in Scottsdale's public rights-of-way.

Section 3.1

Geometrics

Design Standards and Policies
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Chapter 3
Transportation

Section 3.1
Street Geometrics

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FIGURE LIST

SECTION 3.1
STREET GEOMETRICS

3-101 GENERAL COMMENTS

This section describes the geometric requirements for each street classification: parkway, expressway, major arterial, minor arterial, couplet, major collector, minor collector, local collector, local residential, local commercial and local industrial. While the Circulation Element of the General Plan is a broad based planning tool, Section 3.1 is a tool for use by the design engineer in the application of the General Plan. The requirements described herein are primarily based on safety considerations; therefore, standards that provide a greater degree of safety may be used within reasonable economic limits, but standards that provide a lesser degree of safety may not be used without approval from the Transportation Department General Manager.

While every effort has been made to ensure the accuracy and completeness of these guidelines, the City of Scottsdale shall not be held responsible for any errors or omissions. It shall be the sole responsibility of the design engineer to ensure a proper design and the accuracy and completeness of construction documents containing his or her signature.

A. Use of National Standards

1. Geometric Design Standards
   The American Association of State Highway and Transportation Officials (AASHTO) policy on highway design is an approved reference and is to be used together with this manual.

2. Traffic Control Standards
   All traffic control devices shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) prepared by the U.S. Department of Transportation; City of Scottsdale Design Standards and Policies, Section 3.4 - Bikeways; and Section 3.6 - Traffic Signs and Markings.

B. Street Types

The Circulation Element of the General Plan defines six basic types of streets. These are Freeway, Parkway, Expressway, Arterial, Collector, and Local.

1. Freeways

   Freeways will be designed to safely handle very large volumes of through traffic. Direct access will be limited to widely spaced interchanges. Design, construction, and operations shall be provided by the Arizona Department of Transportation.

2. Parkways

   Parkways are high-volume, high-capacity facilities that provide for regional mobility rather than local traffic movements. Direct access is limited. Parkways have scenic easements that give the added attraction of desert landscaping along these regional routes.

3. Expressways

   Expressways provide for efficient movement of large volumes of through traffic. Direct access is limited to designated intersections.

4. Arterial Streets

   Arterial streets with raised medians provide regional continuity and carry large volumes of traffic between areas of the City and through the City. Full access to abutting commercial and multi-family land uses is limited to median openings. Single-family residential developments may not have direct access to an arterial street.

5. Collector Streets

   Collector streets provide for traffic movement between arterial and local streets, with some direct access to abutting commercial and multi-family land uses. Center left-turn lanes are provided to allow for greater access. Driveway access should be evenly spaced.

6. Local Streets

   Local streets provide direct access to abutting land uses, handle local traffic, and provide access to the collector street system. Local streets normally will not be connected to arterial streets.

   Deciding the location of local collector, residential, commercial and industrial streets is usually part of the development site planning process. Frequently, planning for local streets is influenced by the plans for adjacent developments, which have recently been approved. Project Review will review each preliminary proposal for development and will specify any changes needed to conform with previously planned and approved street alignments. Project Review will also specify the classification for each street involved in the plan.

C. Street Classifications

There are ten street classifications based upon the type and level of use for which the streets are intended. Following is a listing of each street classification followed by the number of the figure that depicts the standard street cross-section for that classification. Design criteria for streets located within the Hillside or Upper Desert/Lower Desert areas are specified in the Development Design Guidelines for Environmentally Sensitive Lands. Figure 3.1-1 depicts the areas within the City where these criteria apply.

STREET CLASSIFICATION	FIGURE
Parkway	3.1-2
Expressway	3.1-2
Major Arterial	3.1-3
Minor Arterial	3.1-4
Couplet	3.1-4
Major Collector	3.1-5
Minor Collector	3.1-5
Local Residential	3.1-6
Local Commercial/Industrial	3.1-7

3-101 DESIGN STANDARDS

Figure 3.1-8 lists most of the design standards data necessary for the design of streets within the City of Scottsdale. Subsequent paragraphs in this booklet discuss this data and provide other standards that could not be included in the table.

A. Street Right-of-Way Requirements

The right-of-way requirements shown in figures 3.1-2 through 3.1-7 are based on the space needed for the street when it is constructed to meet ulitmate development requirements. The right-of-way must also provide space for utilities, cut or fill slopes, sidewalks, bicycle paths, trails, traffic control devices and information signs, fire hydrants, landscaping, transit facilities, and other public facilities that must be located adjacent to street pavements.

Right-of-way widths in excess of the standard widths may be required in special circumstances such as when:

1. Cut or fill slopes cannot be confined within the standard width;

2. Minimum sight distance lines on horizontal curves are not within the standards;

3. Minimum sight distances at intersections are not within the standards;

4. Auxiliary lanes are to be provided.

B. Pavement Cross-Section Slopes

1. Typical Street Cross-Sections

Undivided streets should have a normal crown that is a two-way cross-slope with the cross-section high point on the street centerline. Divided streets should have cross-slope on each pavement section. The high point of each slope on each pavement section shall occur on the edge of the pavement nearest to the median. Unusual conditions may cause cross-slope requirements to vary, but normally, the desirable cross-slope is 2%, with a maximum cross-slope of 3%. Any deviation from the desirable cross-slope is subject to review by the Transportation Department.

2. Cross-Sections in Street Dip Sections
   While dip sections are discouraged, where storm drainage runoff flows must cross the street, dip sections are needed. The pavements through the dip section should have a one-way slope (no crown), curbing and medians must not be raised, and cut-off walls shall be installed in accordance with City of Scottsdale standard details. Transitions back to normal street cross-slopes will be needed at both ends of the dip section.

C. Medians

1. Median Widths
   The width of a median is measured from back of median curb to back of median curb. If the median has no curb, the width is measured between the centers of the continuous, painted median stripes. Median widths are specified in Figure 3.1-8. In special circumstances, the Transportation Department may approve widths other than those listed, but in no case shall a median be constructed with a width less than 3 feet.

2. Paved Medians
   A median less than 4 feet wide should be paved. The paved surface should be crowned and have the same cross-slope as the street pavement. Acceptable paving materials are portland cement concrete or concrete pavers.

3. Unpaved and Landscaped Medians
   Medians that are 4 feet or more in width are normally not paved. The grading of the unpaved areas should be as shown in Figure 3.1-9. If a median is to be landscaped, it shall be not less than 5 feet wide. Landscaping and other median features shall not restrict sight distance for left turning vehicles on the through street. Median landscaping shall not restrict sight distance in the vicinity of intersections for side street traffic, refer to Figure 3.1-8 and 3.1-13.

D. Curbs

1. Vertical Curbs
   Vertical curbs are required for all streets except local residential streets (see Figures 3.1-2 through 3.1-7 and 3.1-8). Vertical curbs may be used where roll curbs are specified if drainage considerations make such use desirable.

   Vertical curbs with gutter are to be constructed in accordance with City of Scottsdale standard details. Vertical curb and gutter type shall match the adjacent pavement slope to the gutter cross slope direction. The curb height shown on the standard detail is 6 inches, but the following variations may be used where appropriate.

   a. Where fire lane or public maintenance vehicle access to abutting property must be provided over the curb, use City of Scottsdale mountable curb and gutter.

   b. If special drainage requirements make a higher curb necessary, the height may be increased to 8 inches maximum and the width of the gutter may be increased to 24 inches.

2. Roll Curb, Ribbon Curb, Maricopa Edge
   Roll curb is preferred for local residential streets except where vertical curb is required, and is to be constructed in accordance with MAG Standard Details. Ribbon curb may be used in lieu of roll curb for local residential streets. When ribbon curb is

used, drainage runoff from the road shall not drain with the road but shall be directed to roadside drainage ditches. See Chapter 2.3 Section 2-303 C - "Design Criteria for Roadside Ditches," and Figure 2.3-3 for a typical cross section. For local rural roads, a Type A Maricopa Edge may be used. The pavement width of the local rural road shall be twenty-four (24) feet. When a Maricopa edge is used, drainage runoff from the road shall not drain with the road but shall be directed to roadside drainage ditches.

3. Cut-Off Walls
   In locations where dip sections are permitted to allow drainage flows to cross roadways, cut-off walls conforming to City of Scottsdale standard details must be installed. Cut-off walls must be at least 3 feet deep and have a top that is flush with the pavement surface. The exposed portion of the cut-off wall will have the appearance of a ribbon curb, with the same width as the street's regular curb and gutter (see Figure 3.1.10). The cut-off walls must extend across the flow path in the dip section to protect the pavement structure during runoffs flows from a 100-year storm. Transitions will be needed between the regular curbs and the cut-off walls at each end of the dip section.

4. Curb Returns
   Vertical curb shall be used through the curb return from PC to PT regardless of whether the tangent curb sections are vertical or roll curb. All curb returns shall be provided with sidewalk from PC to PT of the same width as that provided for the sidewalk behind the tangent curb sections. If no sidewalk is provided behind the tangent curb sections, the curb return sidewalk shall be at least 4 feet wide.

   a. Curb Return Radii
      The radii for curb returns measured to the back of the curbs shall be 25 feet for intersections that involve either a local collector street or local residential street. The radii for curb returns measured to the back of curbs shall be 30 feet for all other street intersections.

   b. Sidewalk Ramp at Curb Return
      A sidewalk ramp shall be constructed at all curb returns in accordance with MAG Standard Details for a 30' curb return radius or for a 25' curb return radius. If a traffic signal exists or is planned, the ramp and apron must provide access to the pedestrian push button.

E. Selection of a Design Speed
   The design of geometric features such as horizontal and vertical curves will depend upon the design speed selected for the street. The choice of the design speed is primarily determined by the street classification. The design speed is the maximum speed for the safe operation of a vehicle that can be maintained over a specific section of a street when conditions are so favorable that the design features of the street govern. Design speeds for the various classifications of streets may be found on Figure 3.1-8. The use of design speeds other than those shown in Figure 3.1-8 must be approved by the Transportation Department General Manager.

F. Superelevation in Curves
   Superelevation is discouraged on horizontal curves in the portion of the city outside the Environmentally Sensitive Lands area.

   1. 0.02 ft/ft Superelevation

Superelevation of 0.02 ft/ft may be used when the standard radius cannot be provided due to circumstances beyond the control of the engineer and the general alignment cannot be changed.

2. Superelevation Greater than 0.02 ft/ft
   Superelevation greater than 0.02 ft/ft may not be used except when approved by the Transportation Department General manager. In no case shall a superelevation exceed 0.06 ft/ft.

3. Transition for Superelevation

    a. The length of superelevation transition shall be based on the superelevation rate and the width of rotation. The axis of rotation shall generally be about the pavement centerline. The transition lengths for a superelevation of 0.02 ft/ft are provided in Figure 3.1-8. For other superelevations, refer to the AASHTO publication, A Policy on Geometric Design of Highways and Streets.

    b. With respect to the beginning or ending of a horizontal curve, one-third (1/3) of the transition should be on the curve and two-thirds (2/3) of the transition should be on the tangent pavement section.

4. Drainage on Superelevated Curves
   Whenever superelevation is allowed on a divided street, a storm drainage system to collect the runoff along the median curb shall be provided. In no case shall nuisance water from the higher traveled way be allowed to cross the lower traveled way.

G. Horizontal Curves
   Horizontal alignments should provide for safe and continuous operation of motor vehicles at a uniform design speed for substantial lengths of street. A horizontal curve is required when the angle of change in horizontal alignment is equal to or greater than one degree. The nature of the surrounding development and topography, and the street classification will establish the factors that determine the radius of a curve.

1. Minimum Radii of Curvature
   The minimum radius of curvature will be determined by the design speed or by the stopping sight distance.

    a. Minimum Radii Based on Design Speed
       Figure 3.1-8 contains the minimum radius of curvature for each street classification with and without a superelevation of 0.02 ft/ft. Wherever possible, the radii used in design should be larger. If stopping sight distance conditions require a larger radius than that shown in Figure 3.1-8, then that larger radius becomes the minimum radius for the curve.

    b. Consideration of Stopping Sight Distance
       When walls, buildings, bridge piers, cut slopes, vegetation, or other obstructions are near the roadway on the inside of a curve, they can block a driver's view of the road ahead. If they are too close, the driver will not have sufficient distance along the curved roadway to stop when a hazardous condition comes into view. For design, the driver's eye is 3.5 feet above the center of the inside lane (the driving lane closest to the inside of the curve) and that the hazardous condition is an object 0.5 feet high in the center of the inside lane. The clear distance, "M," is measured from the center of the inside lane to the view obstruction. Figure 3.1-11 depicts these relationships and a table of minimum stopping sight distances for various design speeds.

2. Reduced Design Speeds on Curves
   The reduction of a street design speed on a curve should be avoided. However, where physical restrictions prohibit increasing the radius of the curve or the clear distance, "M," the design speed for the curved section may be reduced. In such circumstances, signing in accordance with MUTCD is required. The difference between the design speed for the roadway approaching the curve and the design speed for the curve shall not be greater than 10 miles per hour. The design speed for a curved roadway section must not be reduced if the reduction would occur at the end of a long tangent or at any location where high approach speeds may be expected.

3. Compound Curves
   Compound curves should be avoided. However, if site conditions make the use of a compound curve unavoidable, the minimum lengths for tangents between two curves curving in the same direction are listed in Figure 3.1-8. The shorter radius shall be at least 2/3 the length of the long radius when the shorter radius is 1,000 feet or less. Compound curves are not permitted when design speeds require the shorter radius to be greater than 1,000 feet.

4. Tangent Sections Between Curves in the Same Direction
   On two-lane roads, tangent sections are needed between two curves in the same direction. If the pavement cross-sections through, the curves do not have superelevation. (The minimum lengths for tangent sections are listed in Figure 3.1-8.) If superelevation is provided in the curved portions of the roadway, then the tangent lengths will be determined by the superelevation transition lengths indicated in Figure 3.1-8.

5. Tangent Sections Between Reverse Curves and Approaching Intersections
   A tangent section must be provided between two curves that curve in the opposite direction. A tangent section must also be provided between an intersection and a curve. Minimum lengths for tangent sections between reverse curves without superelevation are provided in Figure 3.1-8. If the curve radii are at least 50% greater than the radii required by the design speed, the tangent sections may not be required depending on grades, topography, and vegetation. If superelevation is provided for the curves, then the superelevation transition lengths indicated in Figure 3.1-8 will determine the minimum length of tangent sections between reverse curves.

H. Vertical Alignment
   A vertical curve is required when grade changes are equal to or greater than 1.5%. All sections of a street's vertical alignment must meet passing and stopping sight distance requirements for the design speed established for the street. For further details, see the AASHTO publication, A Policy on Geometric Design of Highways and Streets.

1. Longitudinal Street Grades
   For parkways, expressways, and arterial streets the maximum grade is 6%--for collector and local streets the maximum grade is 9%. The minimum longitudinal street grade for all streets is 0.4%. Wherever possible, longitudinal street grades greater than or equal to the minimum grade shall be provided. Where necessary, grades less than 0.4% may be used with written approval from a City of Scottsdale drainage planner.

2. Vertical Curves
   Properly designed vertical curves should provide adequate sight distance, safety, and effective drainage.

a. Type of Curve
A parabolic vertical curve is to be used. Figure 3.1-12 provides all necessary mathematical relations for computing a vertical curve, either crests or sags.

b. Sight Distance Requirements
Sight distance is the continuous length of street ahead visible to the driver. For vertical alignment design, two sight distances are considered: passing sight distance and stopping sight distance. Stopping sight distance is the minimum sight distance to be provided at all points on multi-lane streets and on two-lane streets when passing sight distance is not economically obtainable. Stopping sight distance shall also be provided in the vicinity of intersections. Figure 3.1-8 lists the minimum passing and stopping sight distances for the various street classifications and design speeds.

1) Stopping Sight Distance
The minimum stopping sight distance is the distance required by the driver of a vehicle, traveling at a given speed, to bring the vehicle to a stop after an object on the road becomes visible. Stopping sight distance is measured from the driver's eyes, 3.5 feet above the pavement surface, to an object 0.5 feet high on the roadway, or currently accepted AASHTO standards.

2) Passing Sight Distance
Passing sight is the minimum sight distance that must be available to enable the driver of one vehicle to pass another vehicle safely, without interfering with the speed of an oncoming vehicle traveling at the design speed should it come into view after the overtaking maneuver is started. The sight distance available for passing at any one place is the distance at which a driver whose eyes are 3.5 feet above the roadway surface can see the top of an object 4.25 feet high on the road, or currently accepted AASHTO standards.

c. Minimum Vertical Curve Lengths
Minimum vertical curve lengths are determined by sight distance requirements for a given design speed.

1) Crest Vertical Curve Lengths
Minimum crest curve lengths are determined by either the stopping sight distance or the passing sight distance, whichever provides the greatest curve length.

a) The minimum crest vertical curve lengths must only meet stopping sight distance requirements on streets with two or more through travel lanes per direction.

b) Two-Lane Streets
Passing sight distance requirements should be met on streets with one through travel lane per direction. When crest curve construction in accordance with passing sight distance requirements would result in the creation of drainage problems or excessive cuts or fills, the curve length may be reduced with the installation of appropriate traffic control measures.

c) Minimum Crest Vertical Curve Length Determined by Stopping Sight Distance

The following equations are to be used to determine the minimum crest vertical curve lengths based upon stopping distance requirements:

When $S_s<L$, $L = (AS_s^2)/1329$

When $S_s>L$, $L = (2S_s) - (1329/A)$

Where:
S_s = Stopping sight distance in feet for a given design speed.
L = Length of curve in feet.
A = Algebraic grade difference in percent.

d) Minimum Crest Vertical Curve Length Determined by Passing Sight Distance.

The following equations are to be used to determine the minimum crest vertical curve lengths based upon sight distance requirements:

When $S_p<L$, $L = (As_p2)/3093$

When $S_p>L$, $L = (2S_p) - (3093/A)$

Where:
S_p = Passing sight distance in feet for a given design speed.
L_p = Length of curve in feet.
A = Algebraic grade difference in percent.

2) Sag Vertical Curve Lengths

Minimum sag vertical curve lengths are determined by either the stoping sight distance or comfort factors. The longer of the two possible minimum curve lengths will be used.

a) Minimum Sag Vertical Curve Length Determined by Stopping Sight Distance

The following equations are to be used to determine the minimum sag vertical curve length based upon stopping sight distance requirements:

When $S_s<L$, $L = (As_s^2)/(400 + 3.5S_s)$

When $S_s>L$, $L = (2S_s) - \{(400 + 3.5S_s)/A\}$

Where:
S_s = Stopping sight distance in feet for a given design speed.
L = Length of curve in feet.
A = Algebraic grade difference in percent.

b) Minimum Sag Vertical Curve Length Determined by comfort Factors

The following equation is to be used to determine the minimum sag vertical curve length based upon comfort factors:

$L = (AV^2)/46.5$

Where:
L = Curve length in feet.
A = Algebraic grade difference in percent.
V = Design speed in miles per hour.

I. Combined Horizontal and Vertical Curves

When horizontal and vertical curves are combined, the horizontal curve shall lead and follow the vertical curve. For additional information on this topic, refer to the AASHTO publication, A Policy on Geometric Design of Highways and Streets.

J. Intersections

Although all intersections share certain common elements, they are not subject to generalized treatment. To minimize conflicts and provide for anticipated traffic movements each intersection must be evaluated with regard to its individual characteristics and designed based on the following factors:

- Traffic factors such as capacities, turning movements, vehicle size and operating characteristics, vehicle speed, pedestrian and bicycle movements, transit operations, and accident history.

- Physical factors such as topography, existing conditions, channelization requirements; and available sight distance.

- Human factors such as driving habits, reaction to surprises, decision and reaction time, and natural paths of movement.

1. Angle of Intersection

A right-angle intersection provides the shortest crossing distance for intersecting traffic streams. It also provides the most favorable condition for drivers to judge the relative position and speed of intersecting vehicles. Where special conditions exist, intersection angles may diverge from a right-angle by a maximum of 2 degrees (4 degrees with approval of the Transportation Department General Manager) on parkways, expressways, arterial streets, and major collector streets; and by a maximum of 4 degrees (15 degrees with approval of the Transportation Department General Manager) on minor and local collector streets, couplets, and local streets.

2. Alignment and Profile

Intersections occurring on horizontal or crest vertical curves are undesirable. When there is latitude in the selection of intersection locations, vertical or horizontal curvature should be avoided. A line or grade change is frequently warranted when major intersections are involved. If a curve is unavoidable, it should be as flat as site conditions permit. Where the grade of the through roadway is steep, flattening through the intersection is desirable as a safety measure.

3. Intersection Sight Distance

In order to provide the opportunity for vehicles at an intersection to safely cross or make left or right turns onto a through street, adequate sight distance must be provided. Sight lines are to be drawn on roadway and landscaping plans to represent the areas that must be free of all objects and topography in excess of 24" above the roadway surface. Figure 3.1-13 depicts the technique used to determine driver's eye locations; a line is then drawn to connect these two points. Continuous unobstructed line of sight must be provided along this line and throughout the approach to the intersection, providing an unobstructed sight triangle to the side street driver. Vegetation placed within the sight triangle shall be of a low variety that remains below 24" when mature. Trees can be considered within the triangle as long as the canopy is above 7 ft. and if it is a single trunk variety.

a. Right-Angle Intersections
If the street intersection legs meet at an angle of 88 to 90 degrees, the sight distances shown in Figure 3.1-8 are to be used with Figure 3.1-13 to calculate the sight triangle. The intersection sight distance shown on Figure 3.1-8 for all street classifications except local industrial was determined assuming passenger car traffic. If high volumes of truck traffic are anticipated on other than local industrial street, the procedures in the AASHTO publication, A Policy on Geometric Design of Highways and Streets should be consulted to determine the necessary sight distances.

b. Skewed Intersections
For skewed intersections where the intersection angles are less than 88 degrees, sight distances must be calculated in accordance with the procedures described in Chapter 9 of the AASHTO publication, A Policy on Geometric Design of Highways and Streets.

c. Intersections within or near a curve
Distances S_1 and S_2 shown in Figure 3.1-13 shall follow the street alignment when the intersection is within or near a horizontal curve.

d. Traffic Safety Triangles
Traffic Safety Triangles should be used as a means to limit the height of structures, vegetation, and other improvements on corner properties immediately adjacent to intersections. **Safety triangles are not to be used as a substitute for intersection sight distance!** Safety triangles provide additional visibility around corners for all intersection approaches, and should be applied to the design of perimeter walls and landscape features. Items within the safety triangle shall be no higher than 24" measured from the roadway surface. Figure 3.1-14 depicts the method used to determine the safety triangle location.

4. Intersections with an Unpaved Leg

If an intersection has a leg that is unpaved, the paving to be placed in the intersection shall extend to the end of the normal curb return location on the unpaved leg at a minimum.

5. Valley Gutters at Street Intersections

a. Locations of Valley Gutters

Valley gutters may only be used across minor and local collector streets, and local residential streets. Exceptions must be approved by the Transportation Department General Manager.

b. Valley Gutter Widths
Valley gutters should be constructed in accordance with City of Scottsdale standard details.

6. Turning Lanes

   A separate turning lane permits separation of conflicting traffic movements and removes turning vehicles from the intersection area. Right turn lanes shall be provided on streets classified as Major Arterial or higher, at all street intersections and at driveways where warranted. For left turn lanes at signalized intersections, dual turn lanes should be considered when the turn volume exceeds 200 vehicles per hour, the opposing through volume exceeds 1,000 vehicles per hour, or the delay to left turning vehicles exceeds 45 seconds. Abrupt reduction of alignment and sight distance standards should be avoided. Figure 3.1-15 shows separate left and right turn lanes. The length of these lanes depends on several factors and must be determined on a case-by-case basis and approved by the Transportation Department.

7. Median Design

   Raised medians are required on parkways, expressways, arterial streets, and couplets to separate traffic flows, channelize left turns, and reduce conflicts. On collector streets, flush or painted medians provide space between the through traffic lanes for left turning vehicles. Required median widths are listed for each street classification in Figure 3.1-8.

   a. Raised Medians

      Raised medians, where required, must be provided in accordance with the applicable City of Scottsdale standard details, with the appropriate median width as noted above.

      1) Spacing and Location of Median Openings

         If a street has a raised median, it is not possible to provide an opening in the median for every street intersection or driveway location. Full median openings should occur at not less than 1/4-mile intervals on parkways, expressways, and major arterial streets. Partial median openings, which allow only left turns off the major street, are acceptable at 1/8-mile spacing. On minor arterials and couplets, full median breaks should be no closer than 1/8-mile intervals. In built up areas, where reasonable alternate access is not available, median openings may be provided at smaller intervals with the approval of the Transportation Department.

      2) Configuration of Median Openings

         If the street intersection legs intersect at an angle of 88 to 90 degrees, the configuration of the median opening is to be determined by the information on Figure 3.1-16. If the streets intersect at an angle less than 88 degrees, the median opening configuration will have to be determined to the satisfaction of the Transportation Department General Manager.

      3) Cross-Slope

         The cross-slope in the median opening shall be limited to 0.02 ft/ft. Median openings on curves with superelevation exceeding 0.02 ft/ft will not be permitted.

   b. Flush Medians

      Flush, painted medians are required on major, minor, and local collector streets. Median widths for these streets are listed in Figure 3.1-8.

3-102 STREET ACCESS AND DRIVEWAYS

A. Driveway Spacing
The following table lists the minimum driveway spacing measured from driveway centerline to driveway centerline, which is acceptable for the indicated types of land use:

LAND USE	STREET TYPE	DRIVEWAY TYPE*	MINIMUM SPACING
Single Family	All	S-1	50 feet
Multi-Family	All	M-1	165 feet
		M-2	330 feet
Commercial	Minor Collector/Local	CL-1	165 feet
	Major Collector/Minor Arterial	CH-1	330 feet
	Major Arterial	CH-1	660 feet
		CH-2, CH-3	1320 feet
Industrial	Minor Collector/Local	CI	165 feet
	Major Collector/Minor Arterial	CH-1	330 feet
	Major Arterial	CH-1	660 feet
		CH-2, CH-3	1320 feet
	Parkway/Expressway	CH-2, CH-3	1320 feet

* See City of Scottsdale Standard Details and Figures 3.1-17 through 3.1-20

A maximum of one driveway opening shall be permitted to a particular site or parcel from each of any one or two abutting streets. One additional driveway entrance may be permitted by the Transportation Department when projected travel demands indicate it is in the interests of good traffic operation and adequate street frontage exists to maintain the above guidelines.

B. Driveway Location Limitations
A new access driveway will not be allowed (measured to the driveway centerline):

1. within 30 feet of any commercial property line except when it is a joint-use driveway serving two abutting commercial properties and access agreements have been exchanged between, and recorded by, the two abutting property owners;

2. when the total width of all driveways serving a property exceeds 50% of the curb line frontage;

3. within 50 feet of the right-of-way line of an intersecting non-arterial street;

4. within 100 feet of the right-of-way line of an intersecting arterial street;

5. within 100 feet of an approved median opening location on an arterial street;

6. less than the minimum spacing as established by the table under paragraph 3-103A;

7. when adequate sight distance cannot be provided to vehicles on the driveway attempting to access the street (see Figure 3.1-13).

C. Protection of Access

Except at approved access points, for proper control of driveway access, a vehicular non-access easement shall be granted to the City along all arterial streets when abutting property develops.

D. Residential Development Driveways

1. Single Family Residential Development

Driveways serving single family residential units should be S-1 type driveways as shown on Figure 3.1-16. Only one driveway per lot street frontage is allowed except where the street frontage is of sufficient length to maintain a separation of 50 feet between driveways. The minimum driveway length is 20 feet, measured from the face of the garage opening to the back of sidewalk or the back of curb if no sidewalk is provided.

2. Multi-Family Residential Development

The M-1 and M-2 type driveways shown on Figure 3.1-17 are to be used to serve multi-family developments. Type M-1 is a low-volume driveway serving more than three off-street parking stalls for more than two dwelling units. Type M-2 is a high volume driveway serving more than 50 dwelling units and is normally on a major collector or an arterial street. With the Transportation Department General Manager's approval, Type M-1 and M-2 driveways may be widened up to 10 feet on the egress side to provide for a separate left-turn lane. The minimum driveway length is 20 feet, measured from the entrance to the off-street parking area to the back of sidewalk, or to the back of curb if no sidewalk is provided.

3. Limitations on Residential Access

Residential properties that have frontage on a local street as well as on an arterial or collector street shall only access the local street.

In some instances, residential parcels fronting only on arterial or collector streets may be given access if alternate public access is not available. When such access is allowed, the driveway must be circular or it must have a turn-around area to ensure that there is no need for backing onto the street.

E. Commercial and Industrial Development Driveways

Driveways for commercial and industrial development are shown on Figures 3.1-18 through 3.1-20. Figure 3.1-18 depicts the "CL" type driveways, Figure 3.1-19 depicts the "CH" type driveways, and Figure 3.1-20 depicts the "CI" type driveways. The minimum length for a commercial or industrial driveway is 30 feet, measured from the entrance to the off-street parking area to the back of sidewalk or the back of curb if no sidewalk is provided.

1. Commercial Driveways

The "CL" and "CH" type driveways shall be used to serve commercial properties. A "CL" type driveway is to be used for low-volume driveways on low volume streets. A "CH" type driveway is to be used for driveways on arterials, major collectors, and high volume minor collectors or at other locations when required by the Transportation Department. The CH-2 and CH-3 type driveways are to be used at all access driveways opposite median openings.

2. Industrial Driveways
   The CL-1 and CH-1 type driveways shall be used to serve industrial properties. Except under unusual circumstances, other "CL," "CH," and "CI" driveways are not allowed in industrial areas. When the Transportation Department allows them, the related requirements of commercial driveways shall apply. Generally, industrial access is not permitted on arterial or major collector streets; however, if the Transportation Department allows such access, commercial driveway standards shall apply.

F. Driveway Grades
   Driveway profile standards are illustrated in Figure 3.1-21.

G. Deceleration Lanes
   Figure 3.1-15 depicts a deceleration lane. Deceleration lanes are required at all street intersections on Parkway, Expressway and Major Arterials. Deceleration lanes may be required on Minor Arterial and Collector streets, when required by the Transportation Department.

   Deceleration lanes are required in conjunction with driveways on Parkway, Expressway and Major Arterials. Deceleration lanes for driveways may be required on Minor Arterial and Collector streets, and may require additional right-of-way. The lane length must be determined on a case-by-case basis and must be approved by the Transportation Department. To determine the need for a deceleration lane on streets classified as Minor Arterial or Collector, use the following criteria:

   1. At least 5000 vehicles per day using or expected to be using the street;
   2. The 85th percentile traffic speed on the street is at least 35 mph; or 45 mph for a two lane (one lane each direction) roadway;
   3. At least 30 vehicles will be making right turns into the driveway during a one hour period.

3-103 SIDEWALKS

"This section is currently being re-written. Please contact the Transportation Planning Division for the most recent changes. Also please refer to Figures 3.3-4 through 3.3-8, MAG Standard Details 230 & 231, and COS Standard Details 2232 for related issues."

Sidewalks will be provided on all streets except under any of the following conditions:

A. On single-family residential local streets where all lots or parcel widths are 150 feet or more on both sides and shoulders are provided.

B. On single-family residential local streets where all lots or parcels are 35,000 square feet or more in area and shoulders are provided.

C. Along the side of a street where a bicycle path is required. (The bicycle path will also serve as a sidewalk.)

D. In the outer separation between an arterial street and a frontage road.

E. Along all roadways where an improved shoulder is provided.

F. With the concurrence of the Project Coordination Manager, in an area that has been substantially developed without sidewalks and a required sidewalk would create a spot location.

3-104 BRIDGES, RETAINING WALLS, AND STRUCTURAL CLEARANCES

A. Bridges

1. Bridge Roadbed Width
   The clear width of all bridges, including grade separation structures, shall equal the full width of the physical improvements consisting of sidewalk, street, median, and curb and gutter.

2. Approach Guardrail
   If a vehicular railing or safety-shaped barrier is provided which is within 10b feet of a traveled way with or without a sidewalk, approach guardrails shall be installed on all approach ends in accordance with AASHTO guidelines and paragraph 5.d. below.

3. Cross Slope
   The crown is normally centered on the bridge except for one-way bridges, where a straight cross slope in one direction shall be used. The cross slope shall be the same as for the approach pavement.

4. Median
   On multi-lane divided highways, a bridge median that is 26 feet wide or less shall be decked. The decking of all medians greater than 6 feet wide shall be grated to allow natural light into the structure. Exceptions must be submitted to the Transportation Department for approval.

5. Railings
   The railings to be used are the State of Arizona or State of California Department of Transportation standard design railings. There are four types of railings, which are described below:

   a. Vehicular Barrier Railings
      The primary function of these railings is to retain and redirect errant vehicles.

   b. Combination Vehicular and Pedestrian Railings
      These railings perform the dual function of retaining both vehicles and pedestrians on the bridge. They consist of two parts: 1) a concrete barrier railing with a sidewalk, and 2) a metal hand railing or fence-type railing.

   c. Pedestrian Railings
      These railings prevent pedestrians from accidentally falling from the structure and, in the case of the fence-type railing, prevent objects from being thrown to the roadway below the bridge.

   d. Bridge Approach Railings

      1) Approach railings are required at the ends of bridge railings exposed to approach traffic. On divided highways, with separate one-way traffic structures, they shall be placed to the left and right of approach traffic.

      2) On two-way roadbeds with a clear width less than 60 feet across the structure, approach railings shall be placed on both sides of the structure.

3) When the clear width is 60 feet or more, approach railings shall be placed only to the right of approach traffic.

4) Several types of approach railings are available, including Metal Beam Guardrail, Bridge Approach Guardrail (Types I and II), and Safety-Shape Barriers. The type of approach railing selected should match the rail to be used on the bridge. When long runs of guardrail (such as embankment guardrail) precede the bridge, the guardrail should connect to the bridge railing and thus serve the approach railing function.

5) Approach railings shall be flared at their exposed end. The greatest flare offset possible should be used commensurate with the approach roadway. For detailed information, refer to the AASHTO publication, Roadside Design Guide.

B. Retaining Walls

1. Types and Uses
Recommend types of retaining walls include reinforced concrete and structural masonry. Heavy timber construction is not encouraged except when approved by the Transportation Department General Manager. The walls shall also include integral attachments for railings and weep drainage where applicable.

2. Aesthetic Considerations
In general, the materials and design of retaining walls shall match or blend with the adjacent natural features, landscaping, and/or buildings. The surface of the retaining wall should have a low light reflectance. Suggested surface treatments include exposed aggregate, stucco or mortar wash, and native stone, or other surfaces as approved by the Development Review Board.

The height of retaining walls shall not exceed 6 feet except when approved by the Transportation Department General Manager. If approved to retain above 6 feet, terracing is encouraged and the length of the alignment of the retaining walls should be foreshortened by vertical grooves, periodic offsets, and height changes, or other configurations as approved by the Development Review Board.

3. Safety Railings
A safety railing is required on or adjacent to vertical faces such as retaining walls, wing-walls, abutments, etc., and where the vertical fall is 2 feet or more. The safety railing shall be constructed per City of Scottsdale standard details and shall be placed on tope of the vertical face structure of the vertical drop.

C. Structural Clearances

1. Horizontal Clearance

a. A fixed object other than street lights, signal poles and utility poles, will not be allowed within 10 feet of the traveled way unless approved by the Transportation Department and a safety barrier is provided. A lesser clearance may only be allowed when other controls make the desired clearance unreasonable and appropriate traffic barriers are installed. In no case shall a fixed object be allowed within 2 feet of a traveled way.

b. The horizontal clearance to bridge piers, abutments, and retaining walls on all streets shall be not less than 10 feet from the edge of the traveled way.

2. Vertical Clearance
   The minimum vertical clearance shall be 16.5 feet over the entire width of the traveled way of an arterial street or major collector street. On other streets, the minimum shall be 14.5 feet. Exceptions must be submitted to, and approved by, the Transportation Department General Manager.

3-106 SIDE SLOPES

A. Side Slope Standards
   Side slopes should be designed for functional effectiveness, ease of maintenance, and pleasing appearance. For areas greater than 10 feet back of curb, slopes of 4:1 or flatter shall be provided. Steeper slopes may be approved in areas more than 30 feet back of curb when soils are not highly susceptible to erosion, or when a cut is not more than 4 feet. Consult the AASHTO publication, Roadside Design Guide for further details. Cuts or fills greater than 4 feet must be reviewed by the Development Review Board.

B. Slope Rounding
   The top of all cut slopes shall be rounded where the material is other than solid rock. A layer of earth overlaying a rock cut also shall be rounded. The top and bottoms of all fill slopes for, or adjacent to a traveled way, sidewalk, or bicycle path shall also be rounded.

3-107 CONSTRUCTION OF LESS THAN ULTIMATE CROSS-SECTION IMPROVEMENTS

A full street cross-section is required for the interior streets of a development and a complete half-street cross-section for the perimeter streets. However, if the street is a major arterial, four of the six lanes of the full street or two of the three lanes of the half-street may be required. The determination as to whether the unconstructed lanes will be on the outer edge of the cross-section or adjacent to the median location will be made on a case-by-case basis and approved by the Transportation Department.

3-108 CONSTRUCTION OF HALF-STREETS

A. Design of Cross-Section for Half-Streets
   Half-street construction shall consist of a minimum 24-foot wide pavement section. In the event half-street construction is to be provided, the engineer shall design the full cross-section of the street. The plans shall include in dashed lines the half-street, which will be constructed in the future. The half street construction shall provide adequate transitions and tapers to the adjoining roadways.

B. Design of Half-Street to Join Existing Street Pavement
   The half-street shall be designed to match existing construction as much as possible unless doing so is likely to create an unsatisfactory condition. If changes are needed to correct conditions on an existing half-street in order to properly construct the other half of the street, the solutions must be developed with Transportation Department staff on a case-by-case basis. The plans for the new half-street must contain sufficient information on the profile and cross-sections of the existing street to demonstrate that the new construction will match the old construction, result in a full street with proper cross-sections.

C. Culverts Under Half-Streets

A culvert to be provided in conjunction with half-street construction must extend beyond the edge of the traveled way a minimum of 10 feet into the area where the other half of the street will be constructed in the future. The 10-foot distance is measured perpendicular to the street alignment. The culvert capacity, flow line slope and alignment must be based upon the ultimate design requirements for the culvert if it were to be built under the full cross-section where it could be considerably longer.

3-109 PAVEMENT TRANSITIONS

When development causes the widening of a portion of the pavement of an existing road, pavement transitions are required at each end of the widened portion. Design of the various features of the transition between pavements of different widths should be consistent with the design standards of the superior facility. The transitions should be made on a tangent section whenever possible. Locations with horizontal and vertical sight distance restrictions should be avoided. Whenever feasible, the entire transition should be visible to the driver of a vehicle approaching the narrower section. Intersections at grade within the transition area should be avoided.

A. Transition to a Wider Pavement Section

A transition from a narrower cross-section to a wider cross-section shall have a length that is five times the street design speed in miles per hour. See Figure 3.1-22.

B. Transition to a Narrower Pavement Section

A transition from a wider cross-section to a narrower cross-section shall have a length equal to the difference of the two widths in feet times the street design speed in miles per hour or the 85th percentile speed in miles per hour, whichever is greater. Figure 3.1-22 illustrates this requirement.

3-110 FRONTAGE ROADS

Frontage roads for residential access are not encouraged and must be approved by the Transportation Department. Frontage road geometrics shall be based upon specific project requirements, but generally shall not be less than 20 feet in width.

3-111 SUBDIVISION STREET PLANNING

Subdivision street plans should produce the minimum number of intersections and wash crossings, and discourage through traffic. Figures 3.1-23 illustrates a number of concepts associated with desired subdivision street design. The following paragraphs describe certain other concepts and requirements.

A. Existing and Proposed Streets

Existing streets and proposed streets of the Circulation Element of the General Plan, any applicable Master Circulation Plan or Area Plan should be incorporated into the design of new subdivisions. Exceptions shall be approved by the Transportation Department and may require the approval of the Transportation Commission.

B. Street Abandonment

An existing street may be abandoned if it is not a street indicated in the Circulation Element of the General Plan or an Area Plan, and will not eliminate reasonable access to existing properties. The abandonment should alleviate a significant traffic problem and not create a new problem. If a street is approved to be abandoned, the abandonment must occur prior to the submittal of a final plat to the City Council.

C. Cul-de-Sac Street Lengths

A cul-de-sac street is a street that serves more than one property owner and has only one direct access to the public street system. The following requirements apply to both public and private streets. The length of a cul-de-sac is measured between the centerline of an intersecting street and the radius point of the cul-de-sac as shown on Figure 3.1-24. The minimum length of a cul-de-sac is two times radius R1, as illustrated on Figure 3.1-24. A cul-de-sac street shall not be longer than 1,500 feet and it shall not serve more than 25 single-family dwelling units.

D. Dead-End Streets

Dead-end streets will be required where a street connection is necessary to serve adjacent properties that will develop at a future date. When a dead-end street is required and it serves more than four lots, a temporary cul-de-sac shall be provided. In addition, the minimum/maximum length of a dead-end street shall be the same as that of a cul-de-sac street.

E. Bubbles

Bubbles are areas on the roadway expanded to provide a turn-around and additional access or lot frontage on minor collector and local streets. Bubbles are required at intersections where each street extends in only one direction from the intersection. Bubbles are permitted between intersections to improve accessibility to odd-shaped sites or on minor collector streets where direct access is not permitted. The design of a bubble shall be in accordance with either design depicted in Figure 3.1-25.

The bubble radii shown on Figure 3.1-25 are for local residential streets. Radii for cul-de-sac bubbles for other street classifications are shown in Figure 3.1-24. The use of bubbles (except for on a cul-de-sac) on other than local residential streets must be approved by the Transportation Department. Radii appropriate for these bubbles will be established as part of that approval.

F. Alleys

Alleys are discouraged and must be approved by the Transportation Department. However, alleys may be required where other alleys exist within an area or the extension of existing alley or alley system is necessary. Dead-end alleys will not be permitted.

1. Alley Widths

   Residential alleys abutting single-family uses shall be 16 feet in width. For other abutting uses, an alley 20 feet in width shall be provided.

2. Alley Intersections

   Alley intersections and sharp changes in alignment should be avoided. When intersections or alignment changes are allowed, the inside corners shall be cut off on each side to provide a tangent section between the two sides at least 20 feet long as shown in Figure 3.1-26.

3. Alley Paving
   All alleys are to be paved full width with at least 2 inches of asphaltic concrete over 6 inches of A.B.C.

G. Offset Intersections
   Street jogs with centerline offsets less than 250 feet shall not be permitted along arterial and major collector streets, or on minor collector and local commercial and industrial streets where interlocking left turns will occur. Offsets as small as 125 feet are allowed on minor collector and local commercial and industrial streets where interlocking left turns will not occur and on local residential streets.

H. Intersecting Tangents
   A tangent section of roadway is desirable prior to an intersection on a curvilinear street. Minor street intersections with major streets shall have a minimum tangent outside the intersecting right-of-way. See Figure 3.1-8 for design criteria.

3-112 SPECIAL STANDARDS FOR A DEVELOPMENT

A special set of standards for a development that differs from the standards described herein may be desired by a developer. In such a case, a qualified traffic engineer, registered in the State of Arizona, must prepare a preliminary and final traffic design report and secure City approval of the reports before plans incorporating the special standards can be submitted for review and approval.

A. Preliminary Design Report for Special Standards
   A preliminary design report shall be submitted prior to or at the time of preliminary plat submittal. At a minimum, the preliminary report must address the following subjects:

   - Vehicle Trip Generation
   - Roadway Classification
   - Design Speeds
   - Auxiliary and Additional Lane Requirements
   - Parking Requirements
   - Pedestrian, Bicycle, and Equestrian Requirements
   - Traffic Control Device Requirements
   - Special Features and their Influence
   - Transit Facility Requirements
   - Pavement Design

B. Final Design Report for Special Standards
   A final design report shall be submitted prior to or concurrently with the improvement plan submittal. The report shall include a refinement of the preliminary design report and additionally address the following subjects as a minimum:

   - Horizontal and Vertical Alignment
   - Intersection Location
   - Traffic Control Devices
   - Treatment of Special Features

C. City Review and Approval of Special Standards
The following factors will be considered by the City in its review of the report:

- Relationship of the proposed standards to National, State and city standards
- Similarity of the proposed standards to standards utilized in other communities
- Comparison of the proposed standards with alternatives
- Sensitivity of the proposed standards to safety, environmental, and law enforcement concerns

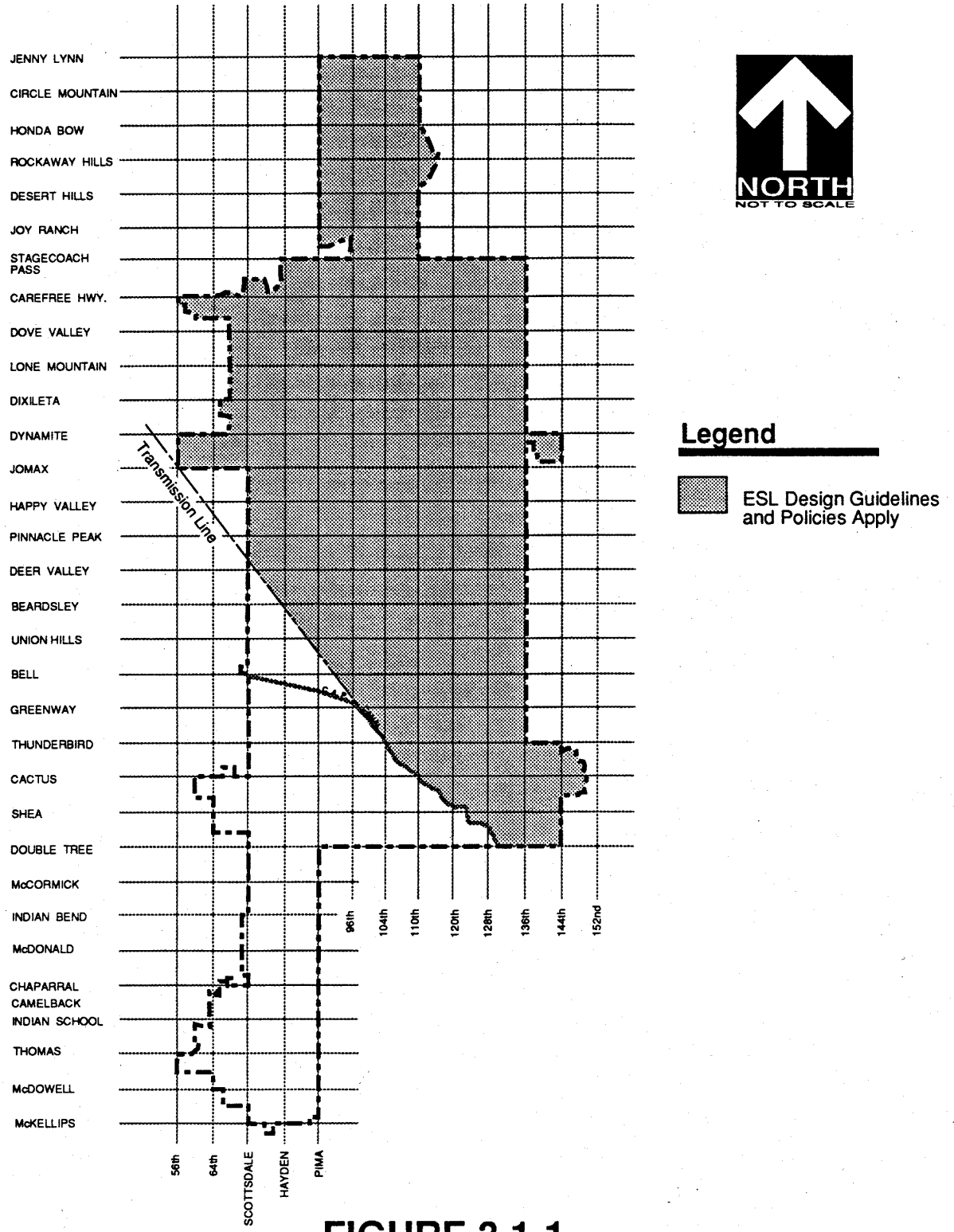
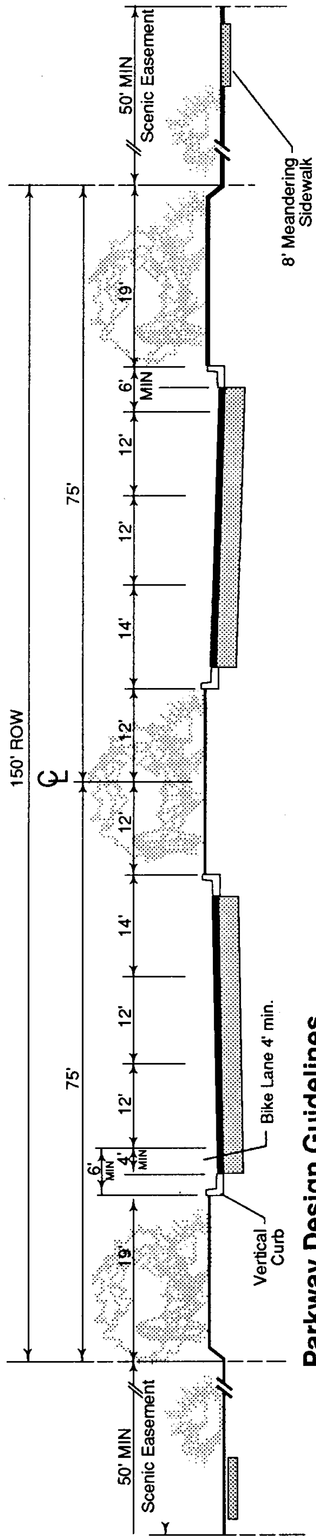


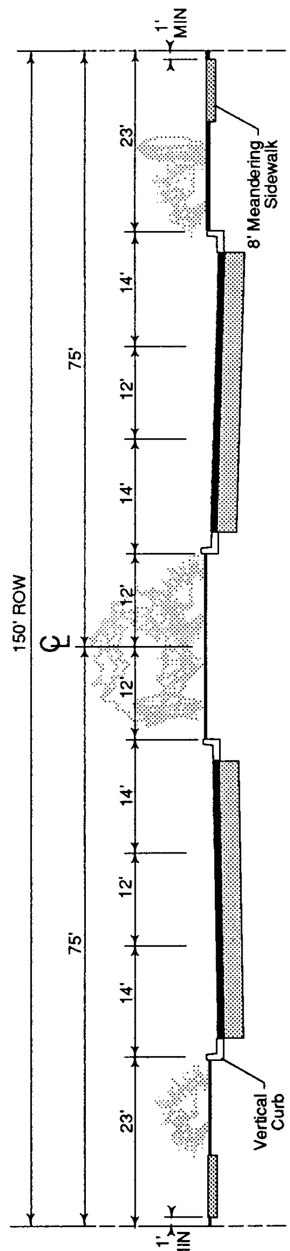
FIGURE 3.1-1

Hillside Area Street Design



Parkway Design Guidelines

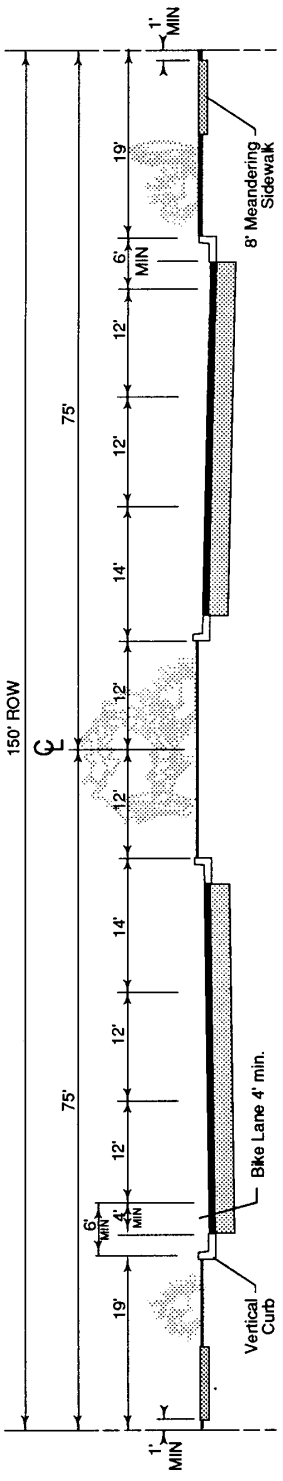
- •Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- •Cross-sections may vary to fit surrounding topography.
- •ADT: 35,000 - 55,000 vpd
- •Design Speed: 55 mph
- •Minimum Grade: 0.4%
- •Maximum Grade: 9.0%



Expressway Design Guidelines

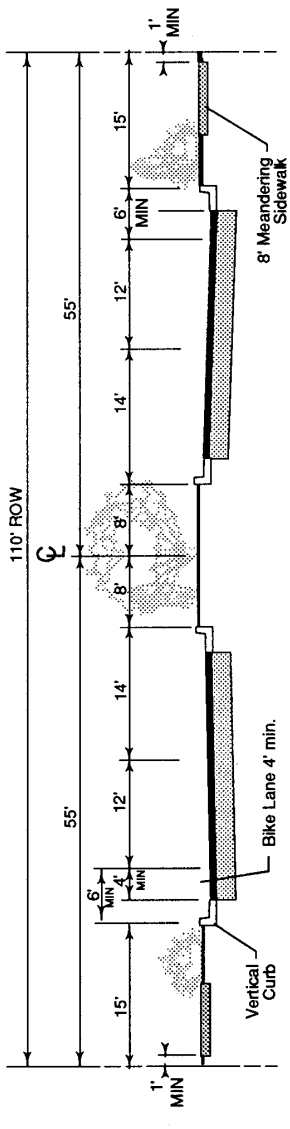
- •Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- •Cross-sections may vary to fit surrounding topography.
- •ADT: 35,000 - 55,000 vpd
- •Design Speed: 55 mph
- •Minimum Grade: 0.4%
- •Maximum Grade: 9%

FIGURE 3.1-2
Parkway/Expressway



Major Arterial Design Guidelines

- Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 35,000 - 55,000 vpd
- Design Speed: 55 mph
- Minimum Grade: 0.4%
- Maximum Grade: 9.0%

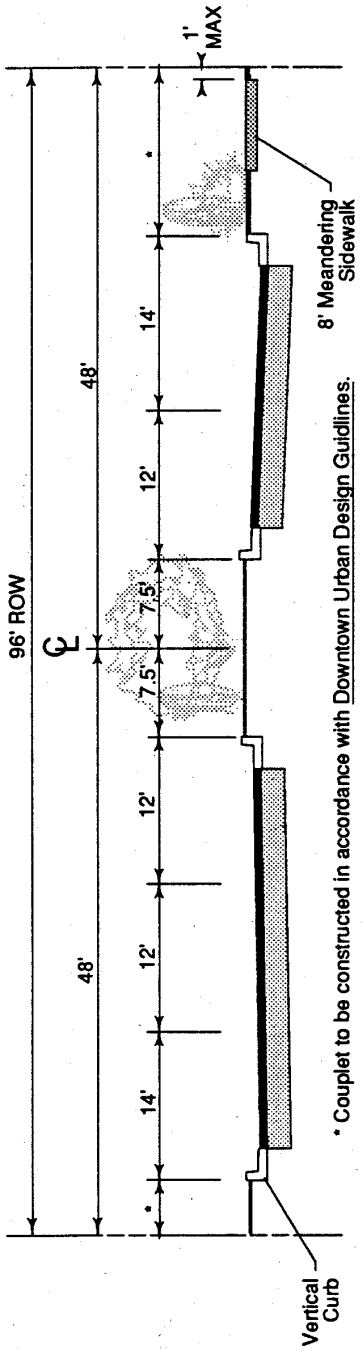


Minor Arterial Design Guidelines

- Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 25,000 - 35,000 vpd
- Design Speed: 55 mph
- Minimum Grade: 0.4%
- Maximum Grade: 9.0%

FIGURE 3.1-3
Arterial Streets

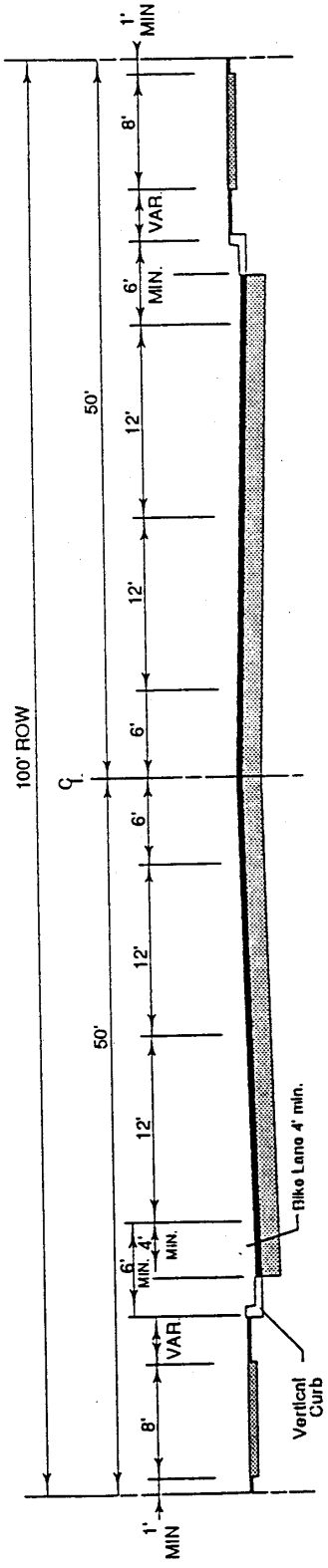
Figure 3.1-3 Updated 10/20/00



Couplet Street Design Guidelines

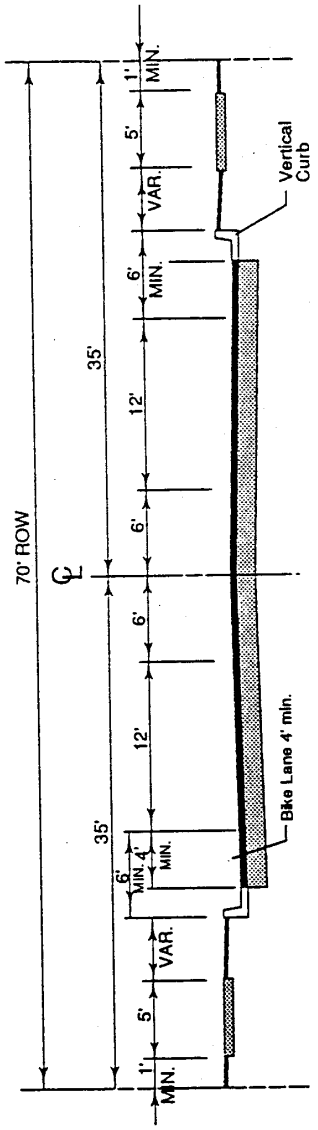
- Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 25,000 - 35,000 vpd
- Design Speed: 45 mph
- Minimum Grade: 0.4%
- Maximum Grade: 9.0%

FIGURE 3.1-4
Couplet Streets



Major Collector Design Guidelines

- Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- Cross-sections may vary to fit surrounding topography.
- ADT: 15,000 - 30,000 vpd
- Design Speed: 45 mph
- Minimum Grade: 0.4%
- Maximum Grade: 9.0%



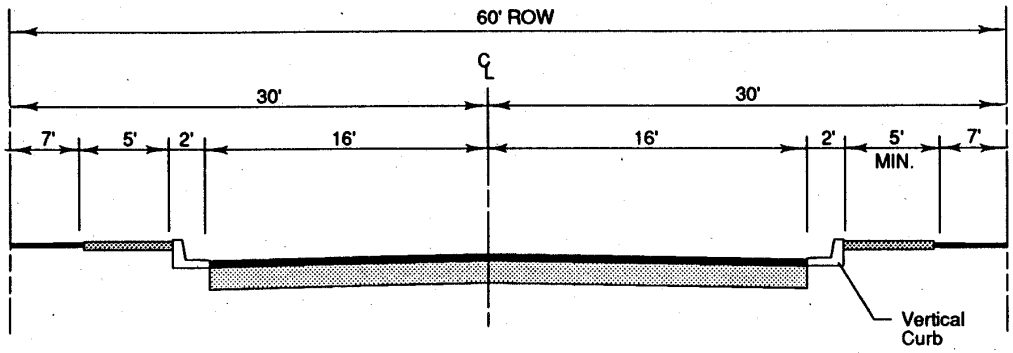
Minor Collector Design Guidelines

- Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- ADT: 5,000 - 15,000 vpd
- Design Speed: 35 mph
- Minimum Grade: 0.4%
- Maximum Grade: 12.0%

FIGURE 3.1-5
Collector Streets

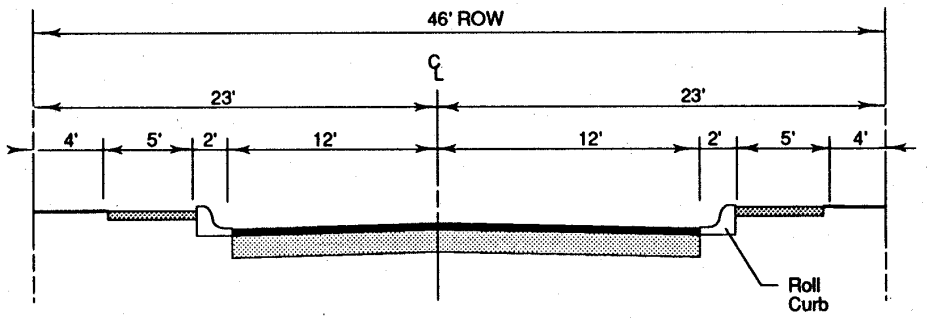
Figure 3.1-5 Updated 10/20/00

FIGURE 3.1-6
Local Streets



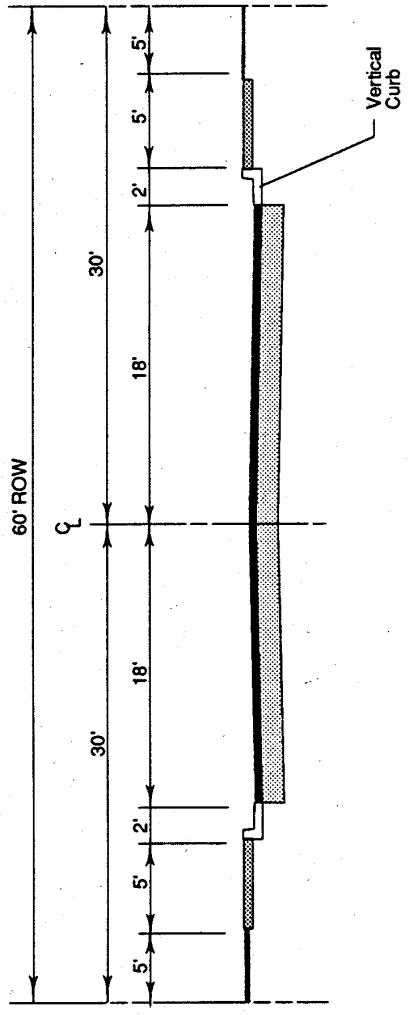
Local Collector Design Guidelines

- *Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.*
- *ADT: 1,500 - 5,000 vpd*
- *Design Speed: 30 mph*
- *Minimum Grade: 0.4%*
- *Maximum Grade: 12.0%*



Local Residential Guidelines

- *Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.*
- *ADT: 1,500 vpd Max.*
- *Design Speed: 20 mph*
- *Minimum Grade: 0.4%*
- *Maximum Grade: 15.0%*



Design Guidelines

- Auxiliary turn lanes may be required at intersections with additional R.O.W. requirements.
- ADT: 1,500 - 5,000 vpd
- Design Speed: 20mph
- Minimum Grade: 0.4%
- Maximum Grade: 15.0%

FIGURE 3.1-7
Local Commercial and Industrial Streets

Street Design Element	Paragraph	Pkwy	Expwy	Major Arterial	Minor Arterial	Couplet	Major Collector	Minor Collector	Local Collector	Local Residential	Local Commercial	Local Indrustrial
Full right-of-way width, ft. (see note 2)	3-102A	150	150	150	110	96	100	70	60	46	60	60
Pavement width, ft., measured from back of outside curb to back of outside curb. (see note 2)		112	104	108	80	79	72	40	36	28	40	40
Median width, ft. (C-curbed median and P-painted median) (see note 2)	3-102C	24C [1]	24C [1]	24C [1]	16C [1]	15C [1]	12P	12P	12P	None	None	None
Type of curb (V-vertical curb and R-rolled curb) (see note 2)	3-102D	V	V	V	V	V	V	V	V	R	V	V
Design speed, miles per hour	3-102E	60	60	55	55	35	45	35	30	20	20	20
Length of transition for 2% super-elevation, ft.	3-102F	350	350	320	240	170	210	135	150	150	150	150
Minimum radius of horizonal curve without superelevation, ft.	3-102G	2400	2400	1800	1800	650	1100	650	450	200	200	200
Minimum radius of horizonal curve with 2% superelevation, ft.	3-102G	1750	1750	1350	1350	500	850	500	350	150	150	150
Minimum length of tangent between reverse curves, ft.	3-102G	350	350	300	300	200	250	200	150	100	100	100
Minimum length of tangent between curves in same direction, ft.	3-102G	700	700	660	660	400	500	400	300	250	250	250
Maximum horizonal curve length, ft.	3-102G	660	660	500	500	400	500	400	250	100	100	100
Stopping sight distance, ft.	3-102H	590	590	500	500	225	365	225	200	125	125	125
Passing sight distance, ft.	3-102H	2100	2100	1950	1950	1300	1650	1300	1100	800	800	800
S_1 Intersection sight distance in ft. on driver's left for right turns, left turns and through traffic.	3-102J	725	710	650	610	395	500	325	300	190	200	355
S_2 Intersection sight distance in ft. on driver's right for left turns or straight through traffic.	3-102J	950	930	860	780	495	620	415	355	220	240	395
Minimum tangent length approaching intersection	3-102J	350	350	300	300	200	250	200	150	100	100	100

1. Measured from back of curb to back of curb.
2. These first four design elements may not be used for upper desert/lower desert streets, but the remaining design elements listed above apply to upper desert/lower desert streets. Consult Development Design Guidelines for Environmentally Sensitive Lands for the design elements to replace the four elements excluded above from use on upper desert/lower desert streets.

FIGURE 3.1-8
Basic Design Data for Streets

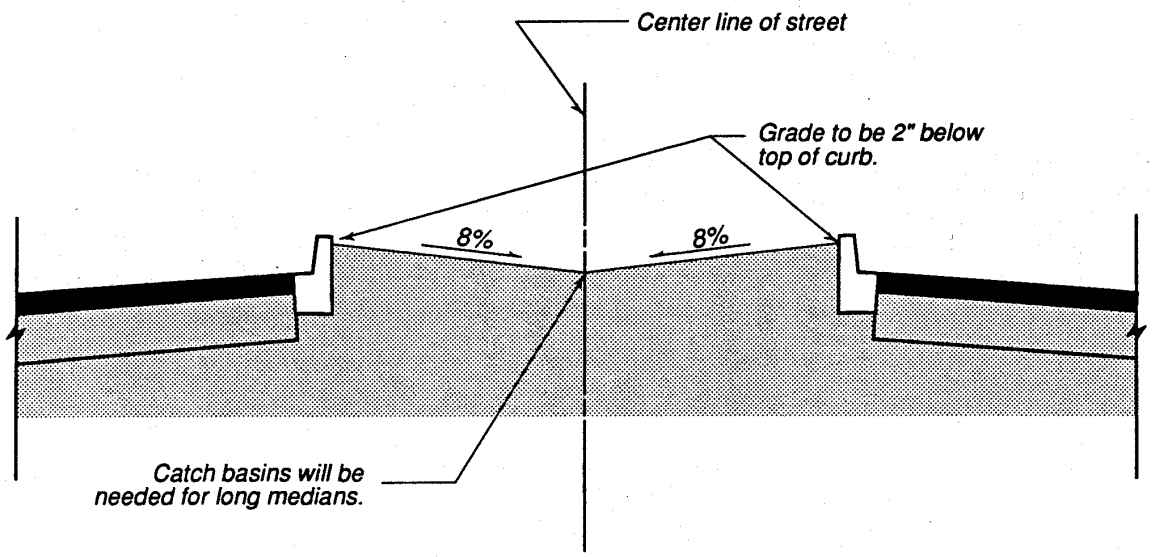


FIGURE 3.1-9
Median Grading

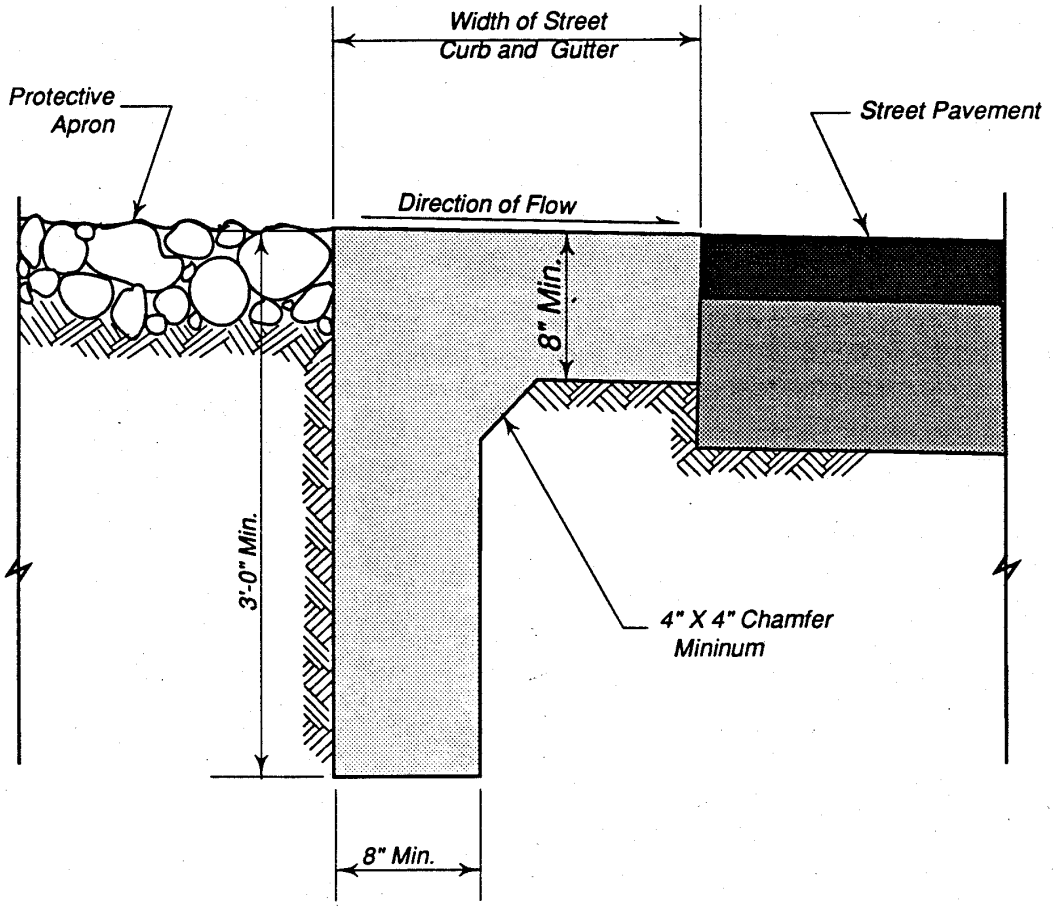
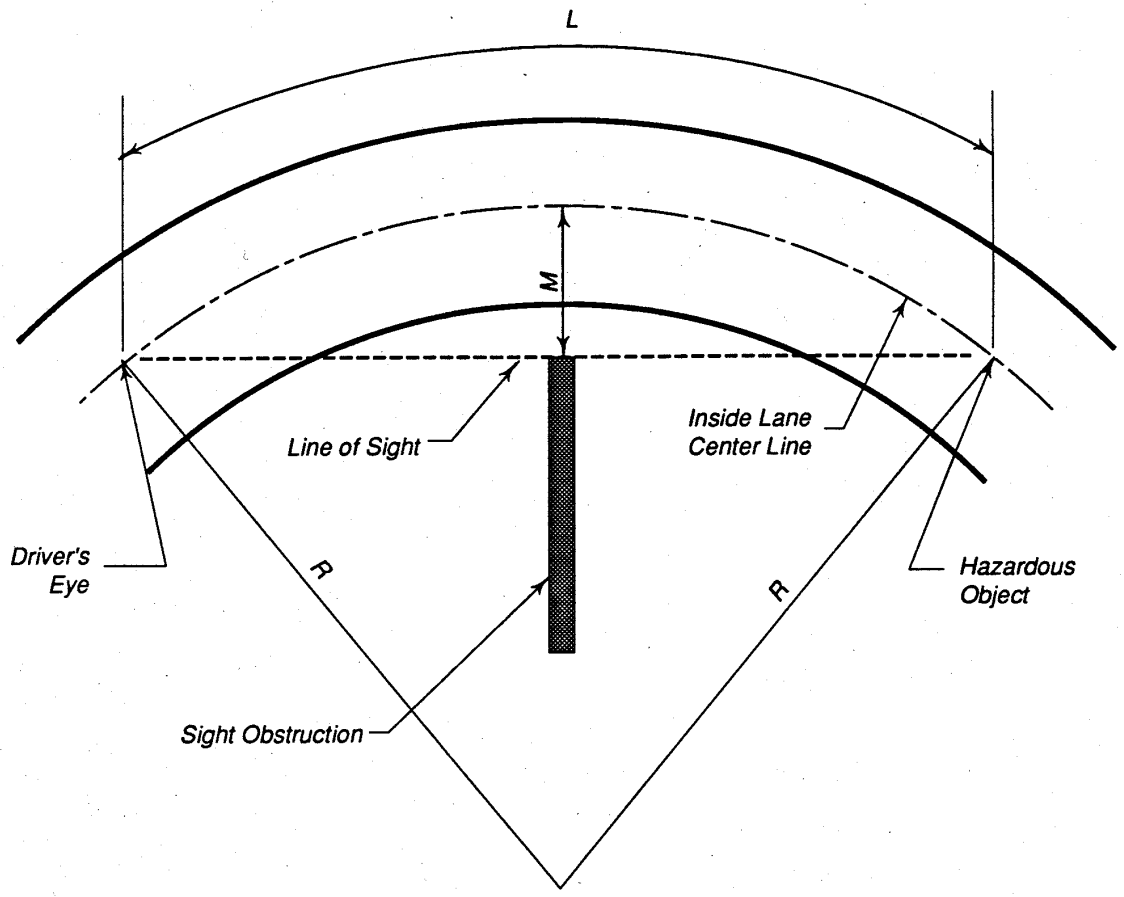


FIGURE 3.1-10
Cut-Off Wall



If the stopping sight distance, S, and the radius to the center of the inside lane, R, are known, the distance, M, is found by the following equation:

M = R[1-COS(28.65 S/R)]

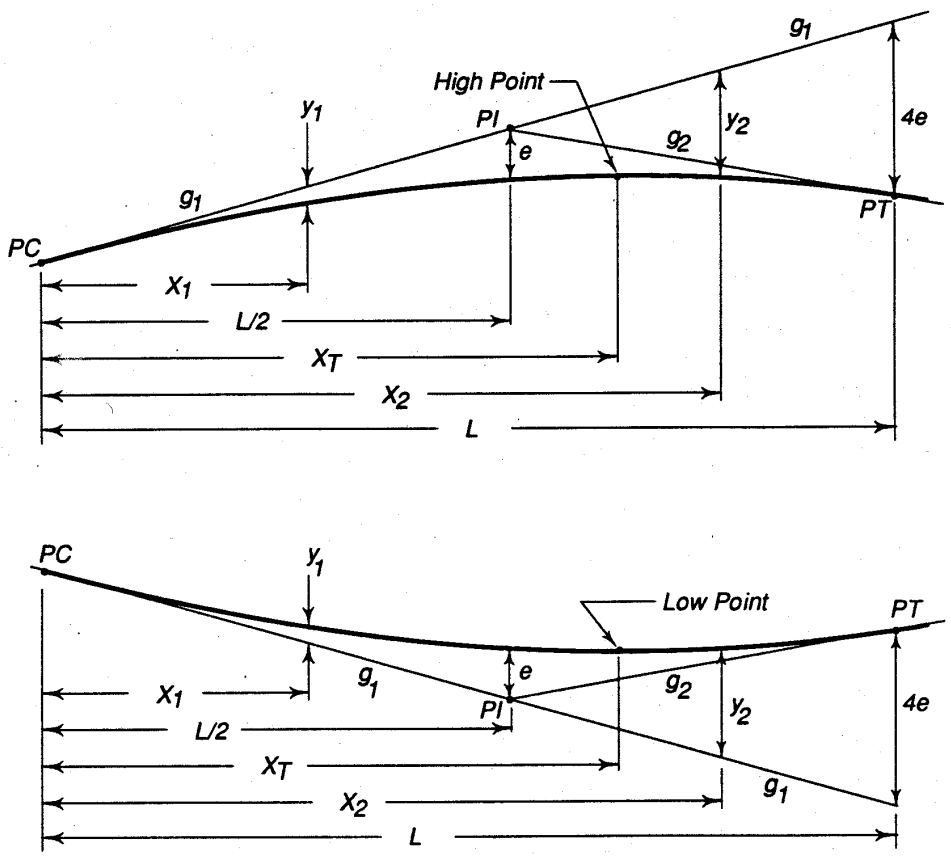
If the radius, R, and the distance, M, are tentatively selected, then the length, L, of the arc in the middle of the inside lane may be found by the following equation:

L = (R/28.65)ARCCOS[(R-M)/R]

If the length, L, is less than the stopping sight distance for the desired design speed, either the radius, R, or the distance, M, must be increased.

Design Speed MPH	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*	*60*	*65*
Stopping Sight Distance, S, (ft.)	*125*	*150*	*200*	*225*	*300*	*365*	*440*	*500*	*590*	*640*

FIGURE 3.1-11
View Obstructions on Horizontal Curves



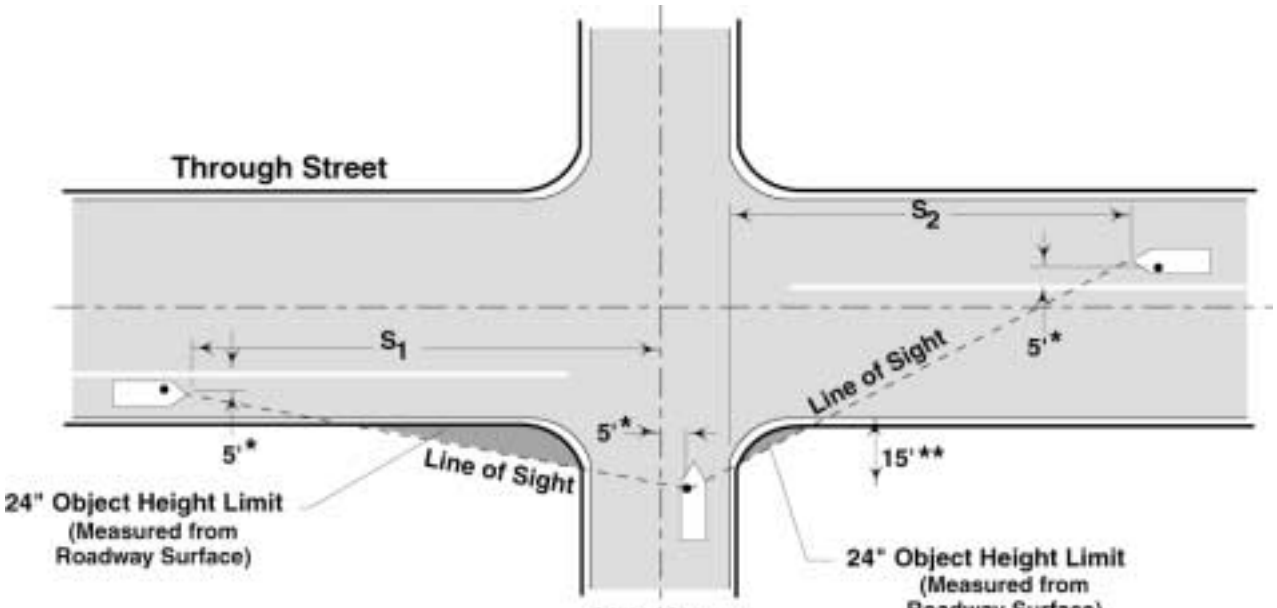
The following equations are for parabolic, vertical curves. The grades g_1 and g_2 must be used with their algerbraic signs (+ or -). If g_1 and g_2 are expressed as percentages, L and X must be expressed in stations. If g_1 and g_2 are expressed as feet per foot, L and X must be expressed in feet. The symbols are defined by the above diagrams.

$$A = g_2 - g_1 \qquad G = g_1 - g_2 \qquad e = LG/8 \qquad y = 4e(X/L)^2 = (A/2L)X^2$$

The equation below provides the location, x_T, of the curve turning point which is the high point or low point on the curve. This equation is only applicable when g_1 and g_2 are not of the same sign, algebraically.

$$X_T = (g_1 L)/(g_1 - g_2)$$

FIGURE 3.1-12
Vertical Curve Relationships



S_1 = Intersection sight distance in ft. on driver's left for right turns, left turns and through traffic.

S_2 = Intersection sight distance in ft. on driver's right for left turns or straight through traffic.

See figure 3.1-8 for distances S_1 and S_2.

Example:

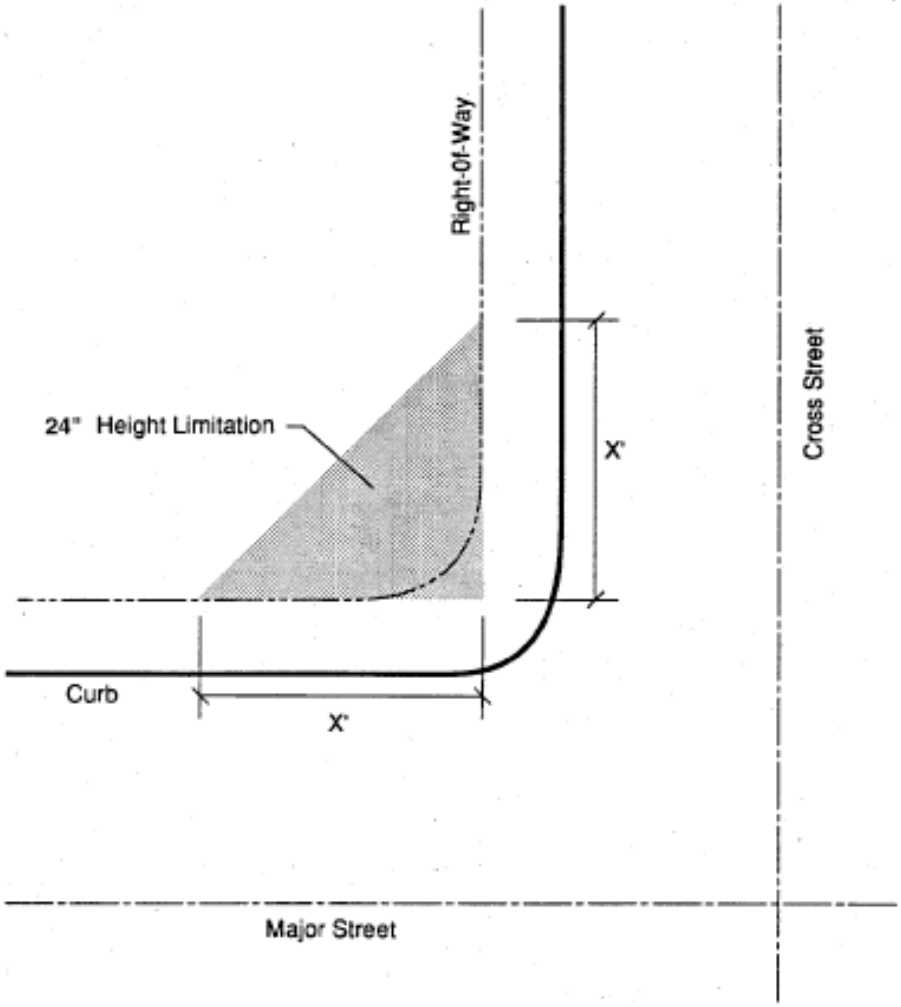
The side street is a local commercial street, and the through street is a major collector street. The design speed for the major collector is 45 MPH. According to Figure 3.1-8:

S_1 = 500 ft. S_2 = 650 ft.

* 5 ft. measured to nearest lane line or centerline.

** 15 ft. measured from face of curb or edge of travelway.

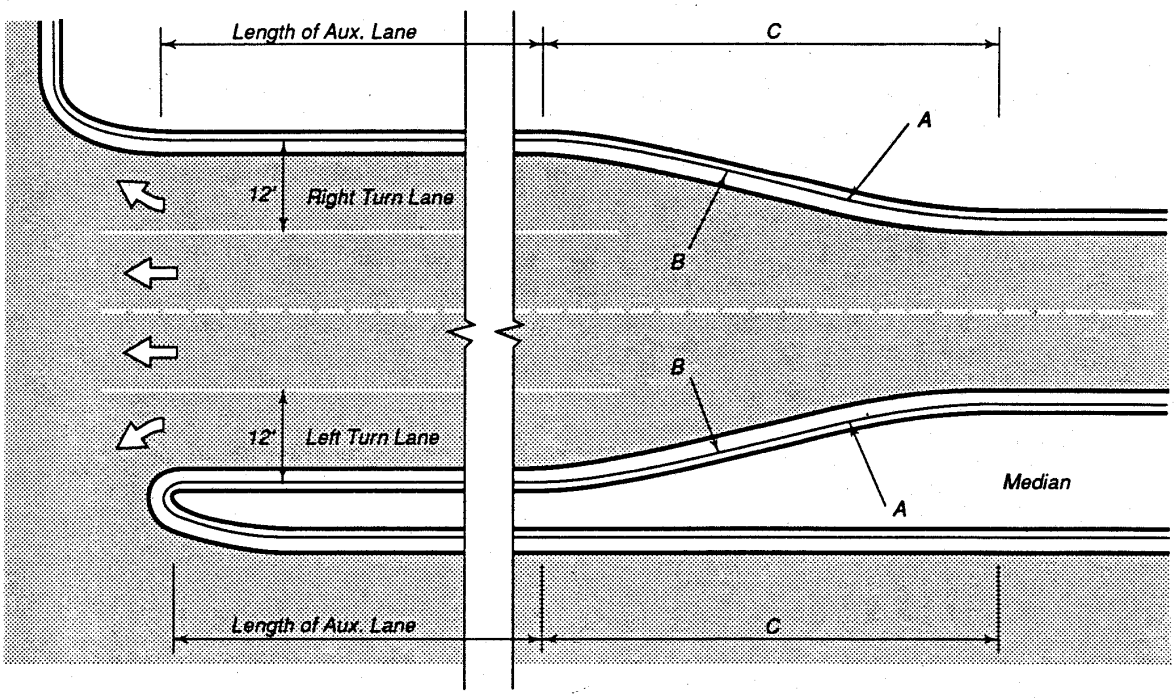
FIGURE 3.1-13
Intersection Sight Distance Requirements



Major Street Classification	X (In feet)
Parkway	25
Expressway	25
Arterials	25
Major Collector	25
Minor Collector	35
Local Streets	35*

*If the standard right-of-way (46' local residential, and 60' local collector) is not available, the safety triangle (X) shall measure 60' on local residential streets and 70' on local collector streets from center lines of the cross streets.

FIGURE 3.1-14
Traffic Safety Triangle on Corner Property

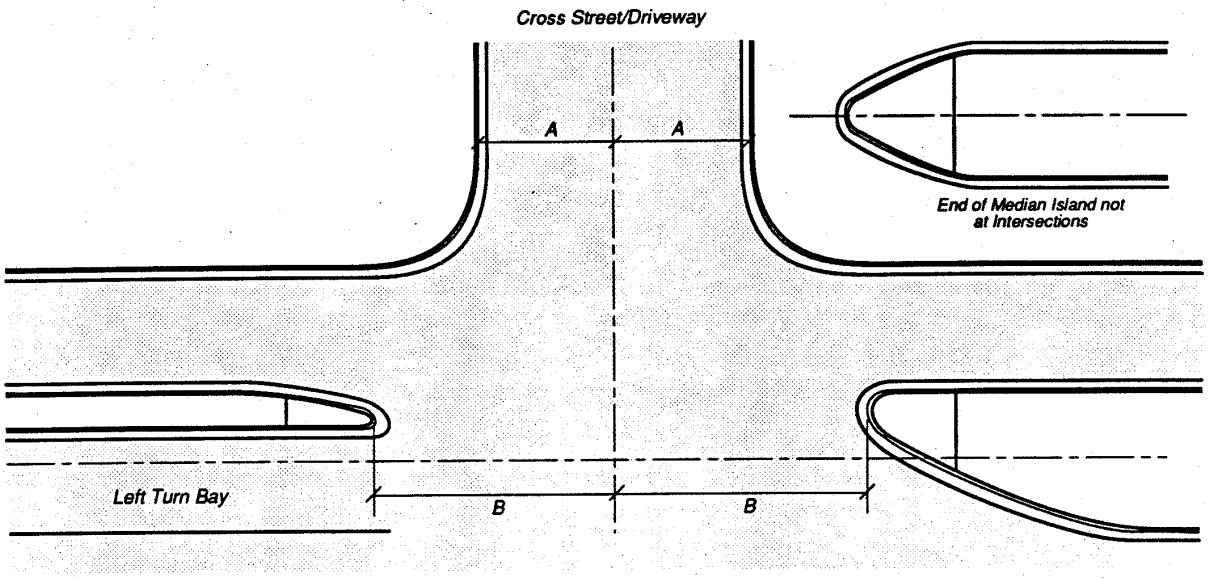


Street Classification	Dimensions in Ft.*		
	A(rad.)	B(rad.)	C
Major Arterial	300	300	153.62
Minor Arterial	300	150	103.23
Collector	150	150	84.00

Auxiliary lane lengths depend on local traffic needs.

*Assuming single left-turn lane; for dual left-turn lanes, consult the City of Scottsdale Standard Details.

FIGURE 3.1-15
Auxiliary Lanes



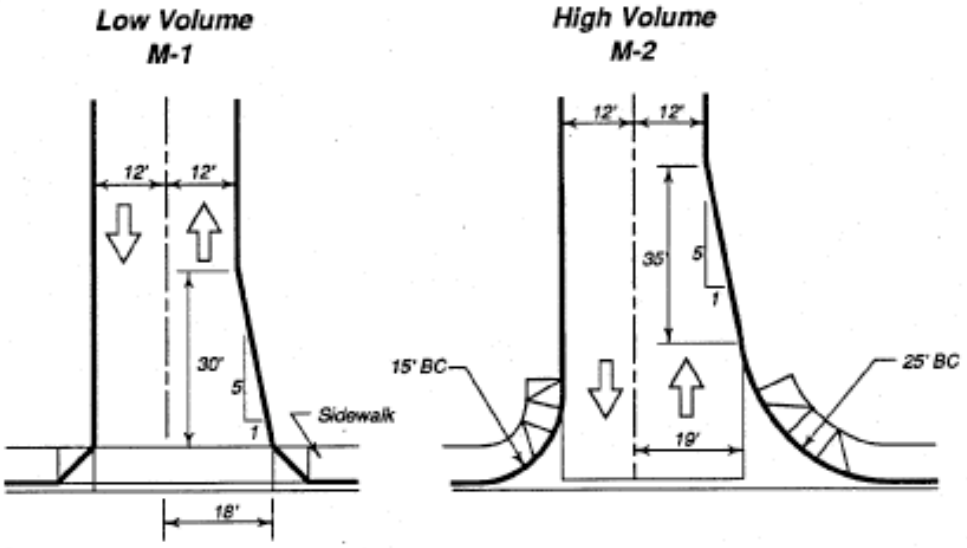
B = A + 14; 40' minimum

NOTES:

1. This sketch is for a three leg intersection. If the intersection has four legs, the right side will also have an auxiliary lane for left turns, and the median on the right side will have the same configuration as the one on the left side rotated 180 degrees.

2. See City of Scottsdale Standard Details for median dimensions.

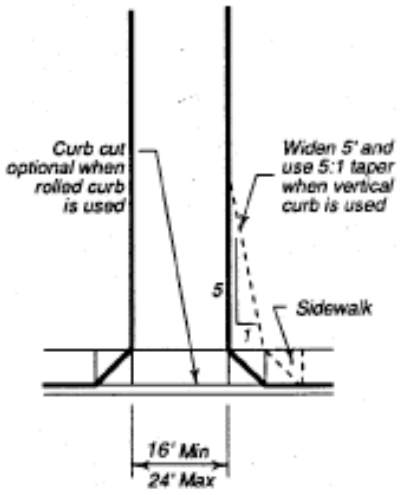
FIGURE 3.1-16
Median Openings for Intersections



Multi-Family Units

Multi-Family Units

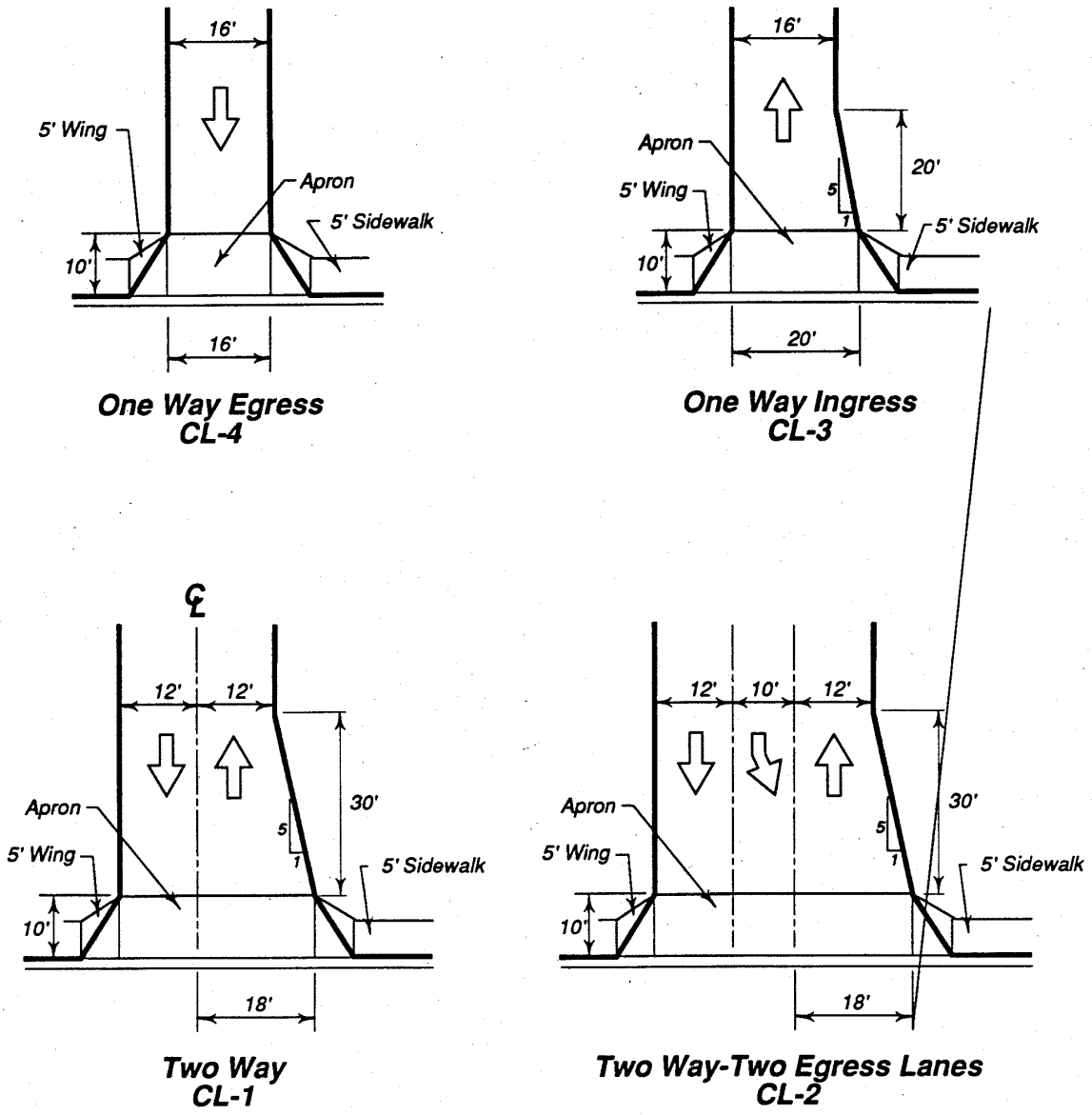
S-1



Single Family Unit

NOTE: See City of Scottsdale Standard Details for more specific information.

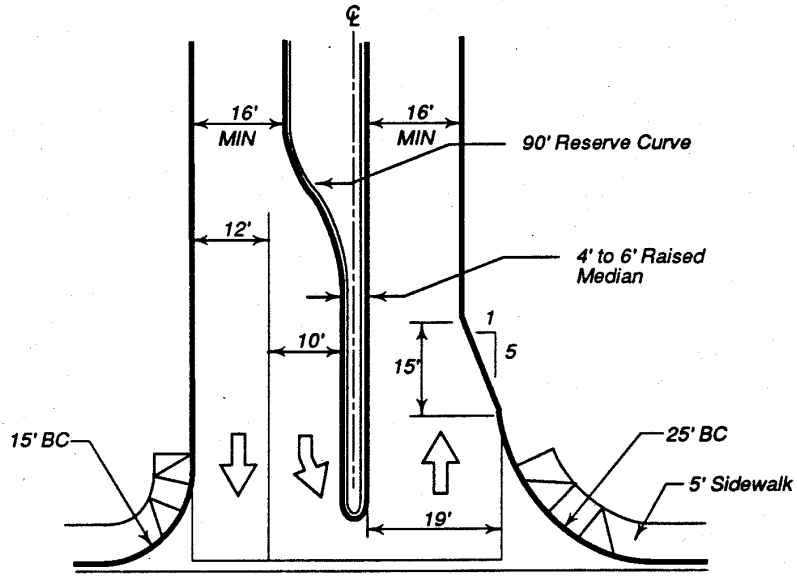
FIGURE 3.1-17
Residential Driveways



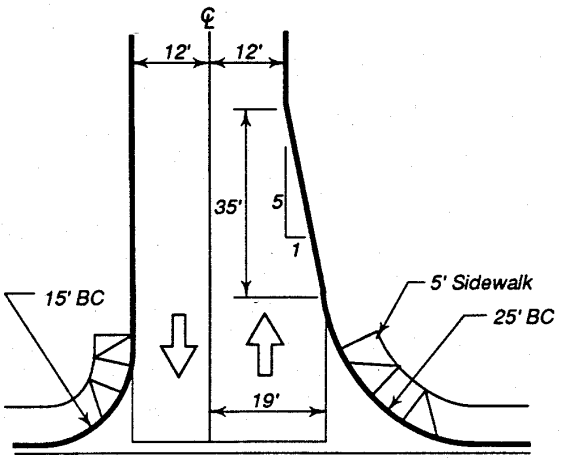
NOTE: See City of Scottsdale Standard Details for more specific information.

FIGURE 3.1-18

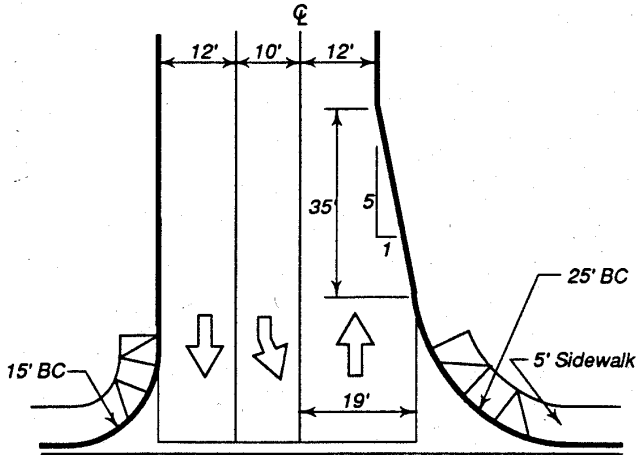
Commercial/Industrial Driveways - Type CL



Two Way Raised Median
CH-3



Two Way
CH-1

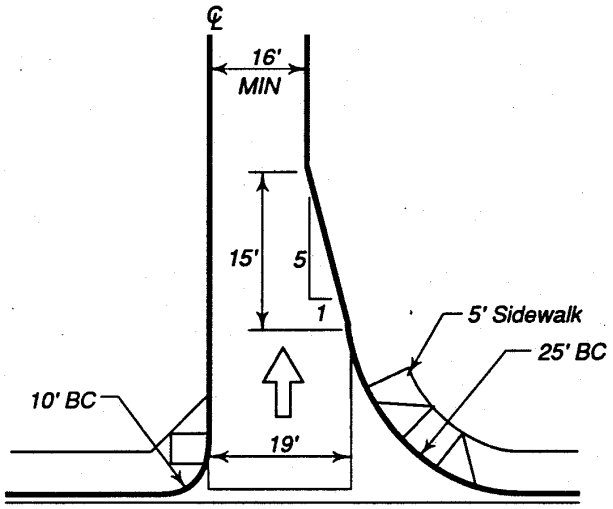


Two Way with Two Egress Lanes
CH-2

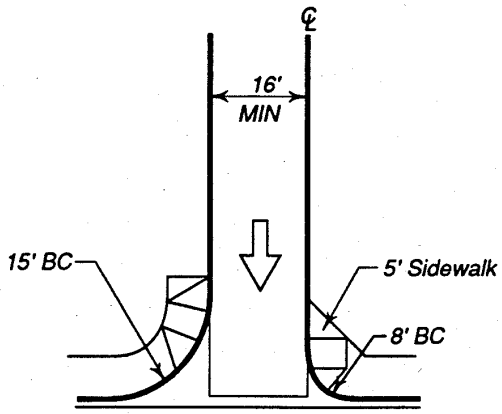
NOTE: See City of Scottsdale Standard Details for more specific information.

FIGURE 3.1-19

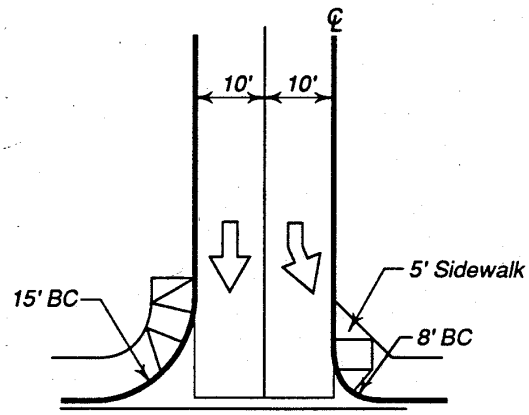
Commercial/Industrial Driveways - Type CH



One Way Ingress
CI-1

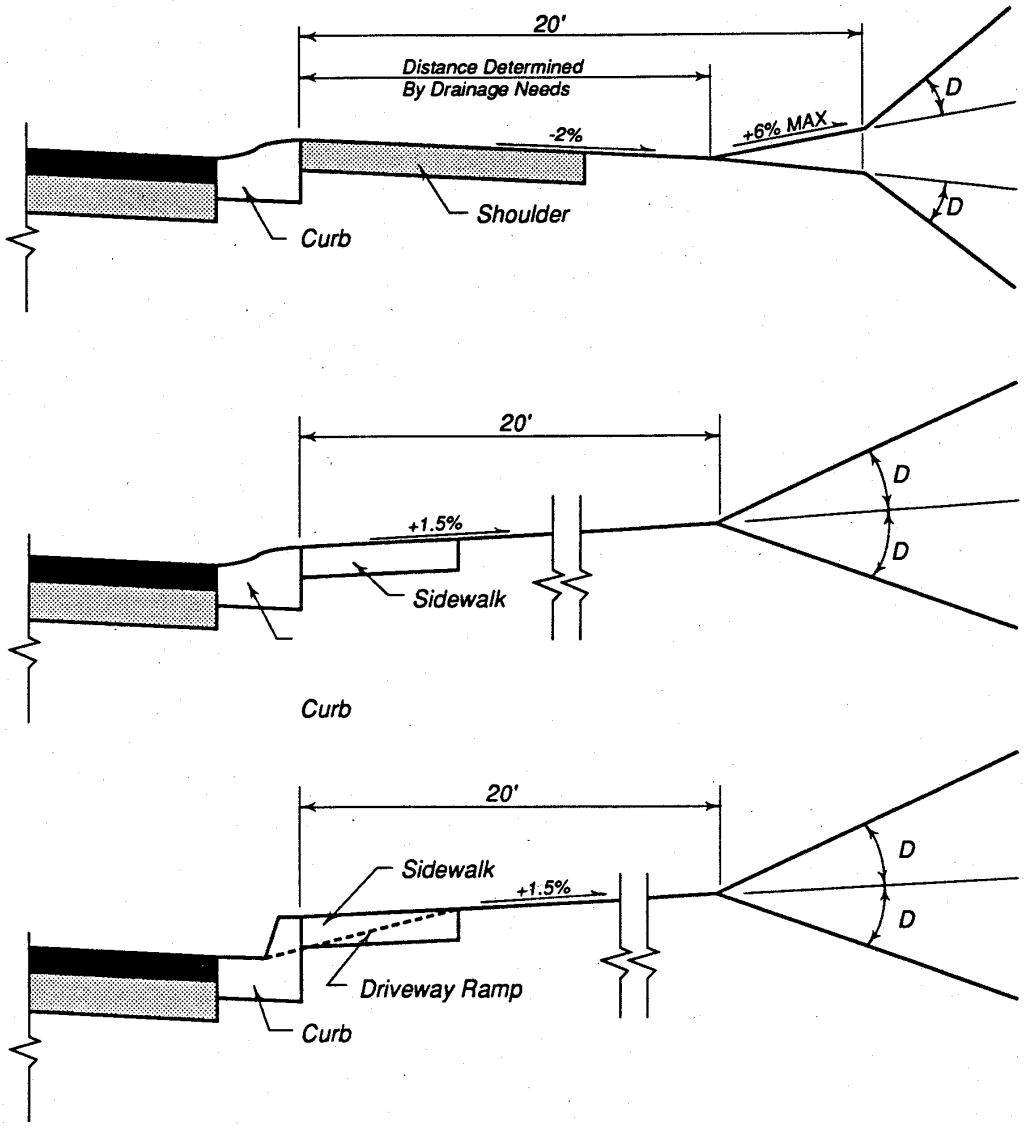


One Way Egress
CI-2



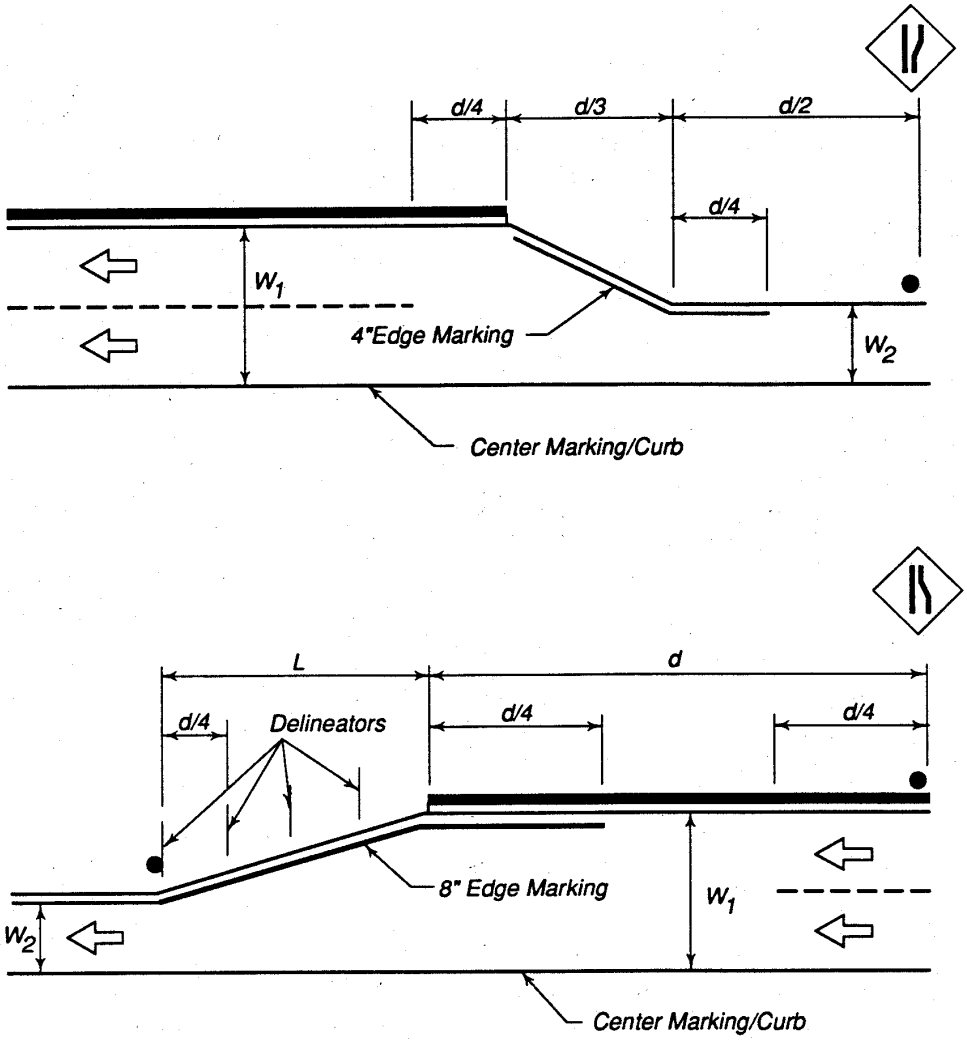
Two Lanes, One Way Egress
CI-3

FIGURE 3.1-20
Commercial/Industrial Driveways Type CI



A.D.T. For Driveway		Grade Difference, D	
		Desirable	Maximum
Low Volume	1-500	6%	10%
Medium Volume	500-1500	3%	10%
High Volume	1500 or More	0%	10%

FIGURE 3.1-21
Driveway Grade Standards



S= *Design Speed or 85 Percentile Speed, Whichever is Higher*

L= WS

$W=W_1 - W_2$

d=15S

FIGURE 3.1-22
Pavement Width Transitions

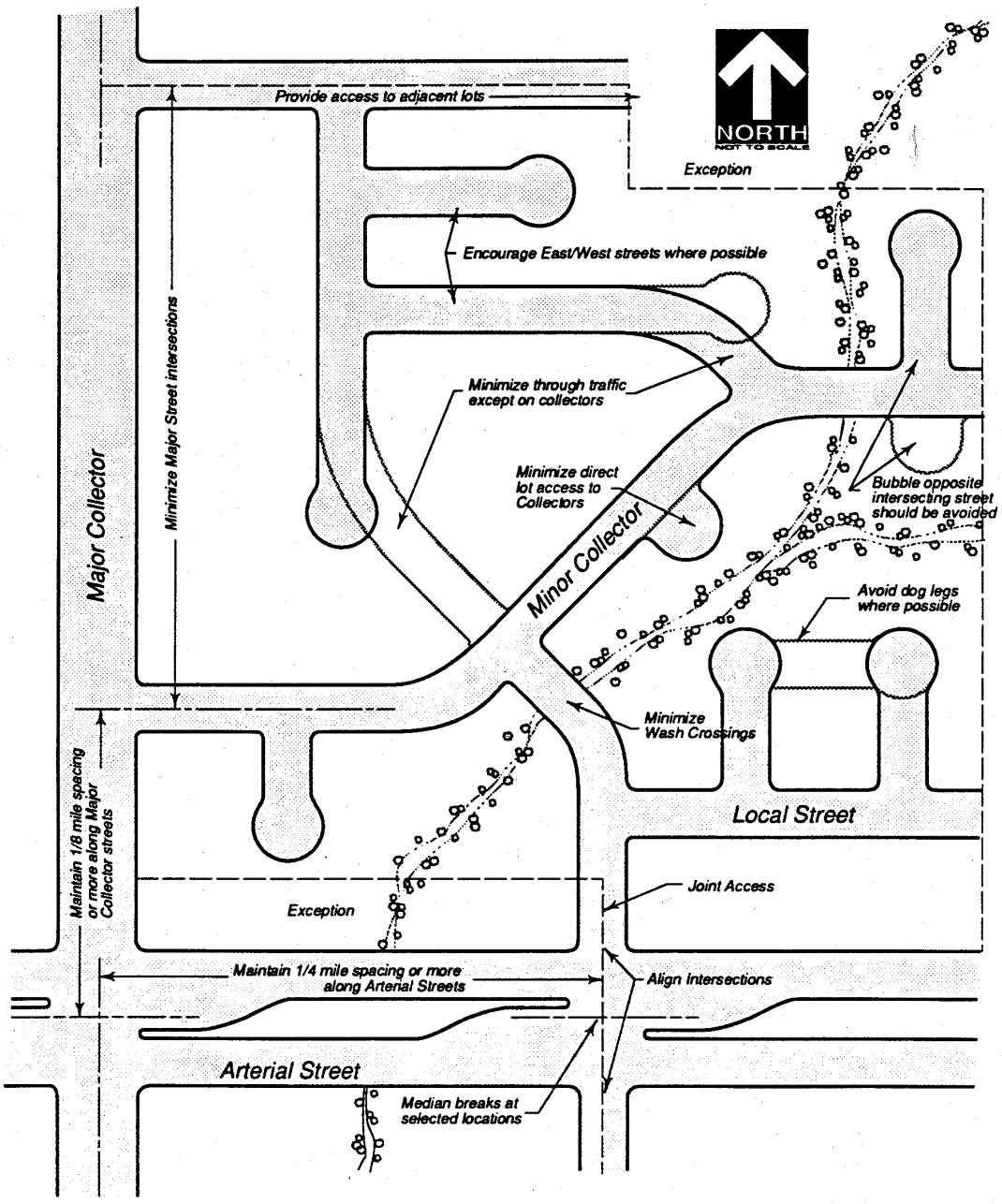
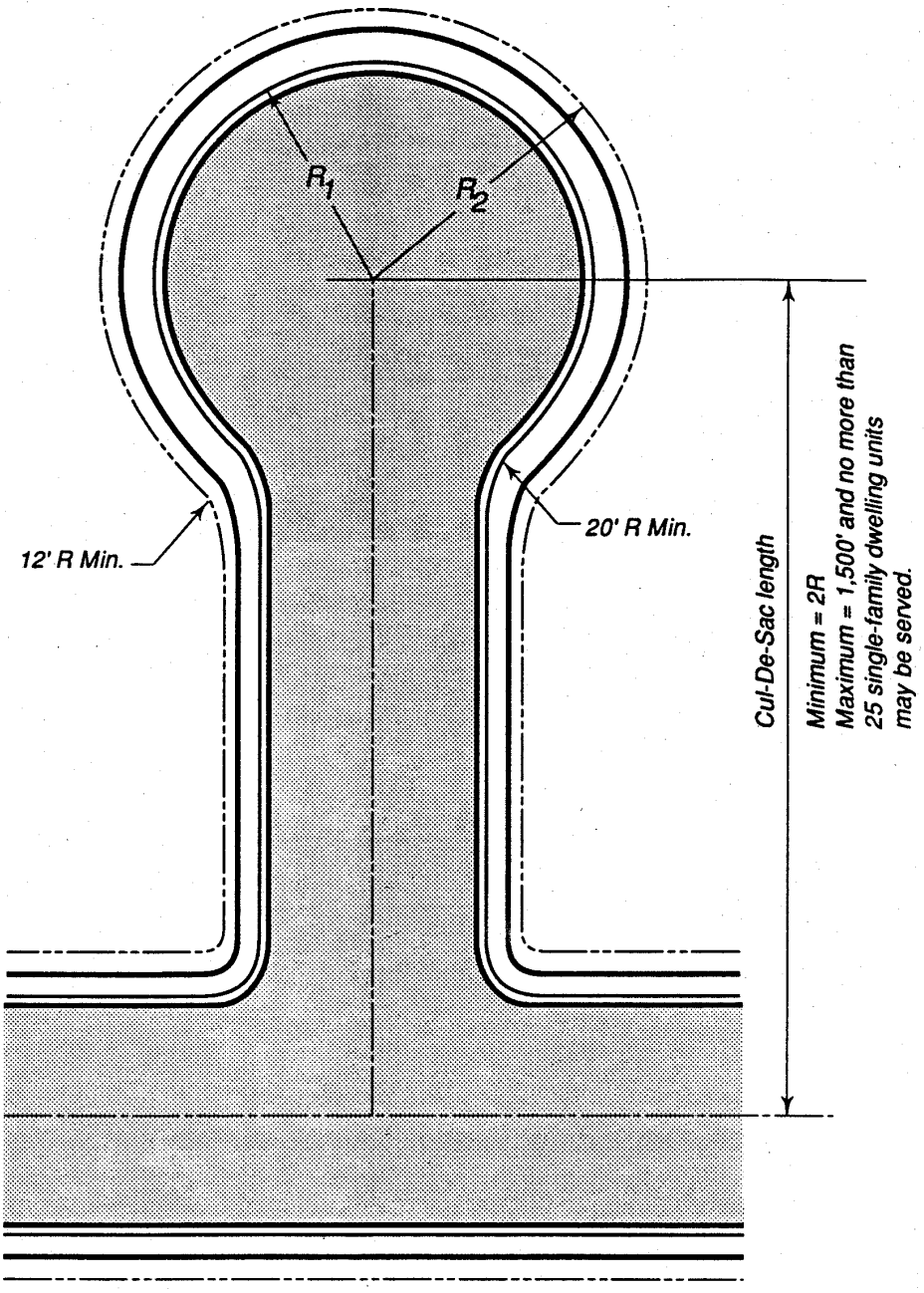


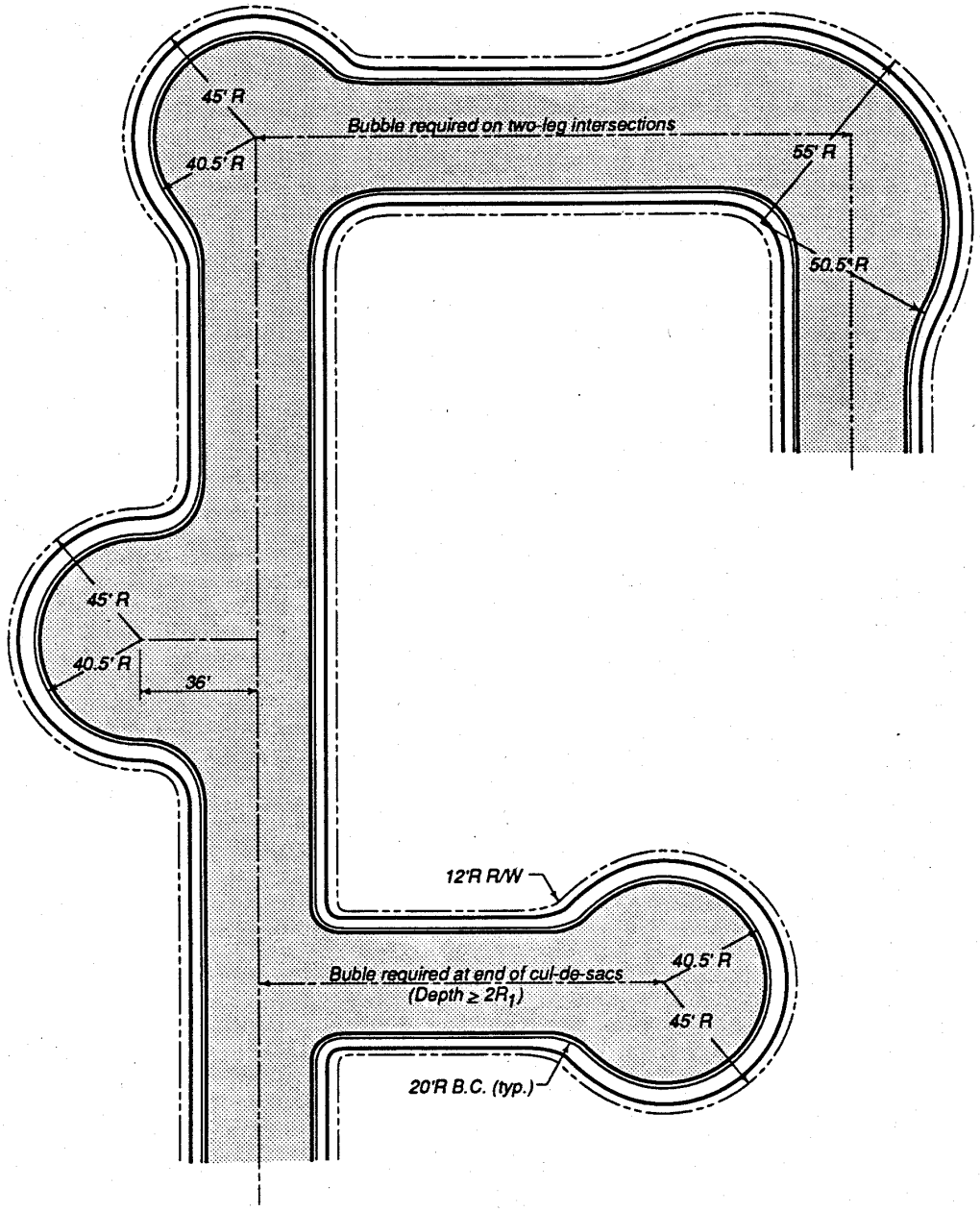
FIGURE 3.1-23
Subdivision Street Planning



Classification of Cul-De-Sac	Bubble Radii, feet R_1(B.C.)	R_2(P.L.)
Local Res., Non-Hillside	40.5	45
Local Commercial *	60.5	70
Local Industrial	60.5	70

*This also applies to multi-family residential development.

FIGURE 3.1-24
Cul-De-Sac Street Length



The bubble radii shown on this figure are for local residential streets. Radii for cul-de-sac bubbles for other street classifications are shown on Figure 3.1-24. The use of bubbles (except for a cul-de-sac) on other than local residential streets must be approved by the Transportation Department. Radii appropriate for these bubbles will be established as part of that approval.

FIGURE 3.1-25
Bubbles For Streets

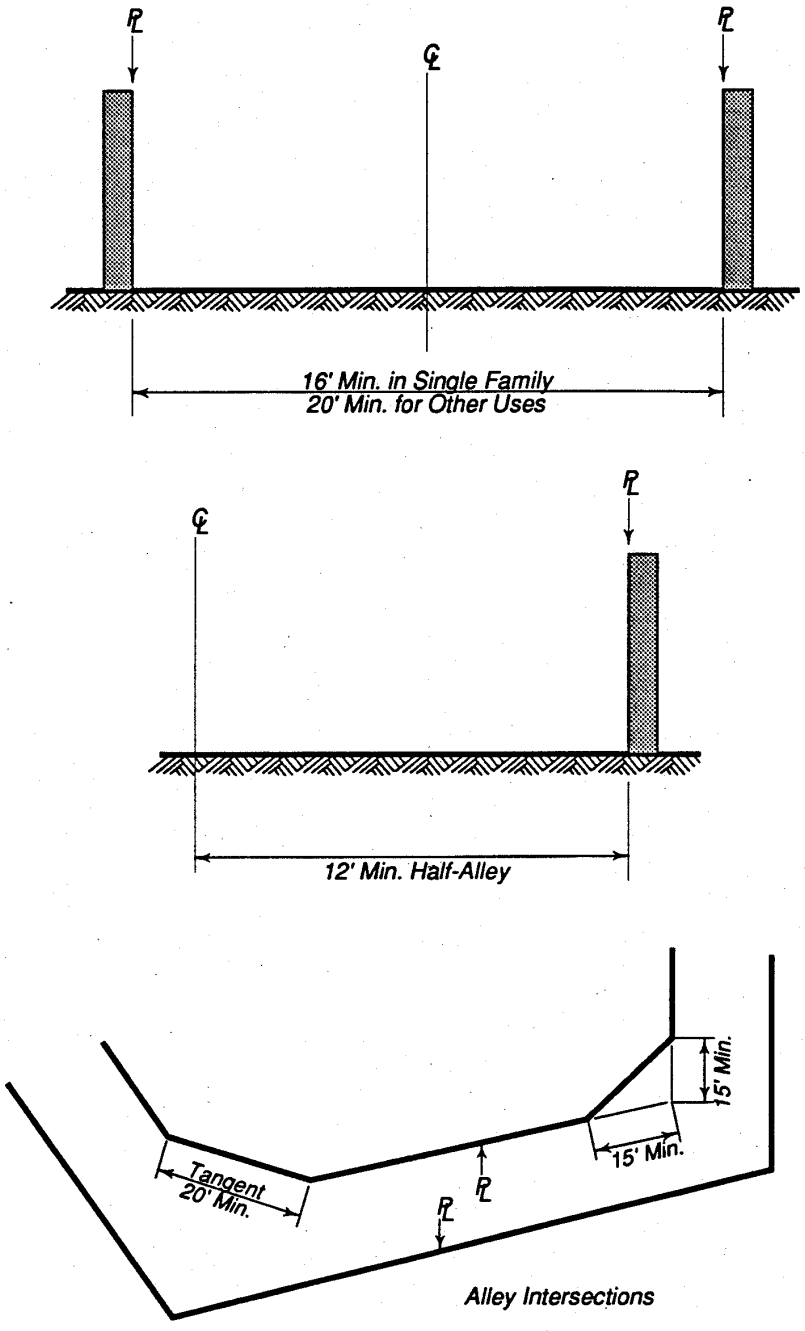


FIGURE 3.1-26

Alley Widths and Intersections

Section 3.2

TRAFFIC SIGNAL DESIGN
Design Standards and Policies
Revised December 1999

Chapter 3
Transportation

SECTION 3.2
TRAFFIC SIGNAL DESIGN

CONTENTS

SECTION 3.2
TRAFFIC SIGNAL DESIGN

3-201 INTRODUCTION

This document presents criteria and procedures to be used when preparing traffic signal plans for the City of Scottsdale. **Issues not addressed in this document should be directed to the City of Scottsdale, Transportation Systems Department, Operations Division, (STSDOD), at (480) 312-7623.**

3-202 CITY OF SCOTTSDALE TRAFFIC SIGNAL POLICIES

The following policies have been adopted by the City of Scottsdale City Council. Requests to deviate from these policies must be submitted in writing to the Transportation Systems Department for consideration.

- Install warranted traffic signals to maintain one-half mile signal spacing on expressways, parkways, and major and minor arterials. Spacing must be consistent with the City's traffic control system plan.

- Install warranted traffic signals to maintain one-quarter mile spacing on major collectors. Spacing must be consistent with the City's traffic control system plan.

- Install warranted left-turn arrows based upon established City of Scottsdale criteria.

- Require a traffic signal plan when a new traffic signal is to be constructed or when an existing signal, or any part of an existing signal, is to be modified in any way.

- Require any traffic signal construction, private or public, to be supervised by a certified I.M.S.A. Level II Signal Technician.

3-203 TRAFFIC SIGNAL DESIGN CRITERIA

A. Abbreviations
Abbreviations are defined as follows:

AASHTO	- American Association of State Highway and Transportation Officials
ADOT	- State of Arizona Department of Transportation
AHD	- Arizona Department of Transportation Highways Division
APS	- Arizona Public Service Company
ASTM	- American Society for Testing and Materials
COS	- City of Scottsdale
FHWA	- Federal Highway Administration
IMSA	- International Municipal Signal Association
ITE	- Institute of Transportation Engineers
MAG	- Maricopa Association of Governments
MUTCD	- Manual on Uniform Traffic Control Devices
NEMA	- National Electrical Manufacturers Association
SRP	- Salt River Project
SSPC	- Surface Structure Painting Council
STSDOD	- Scottsdale Transportation Systems Department, Operations Division
CAL-TRANS	- State of California Department of Transportation
USDOT	- United States Department of Transportation
QPL	- City of Scottsdale "Qualified Products List"
QPL-CAL	- CAL-TRANS "Qualified Products List"
TSCA	- Traffic Signal Control Assembly
RCU	- Remote Control Unit

B. Design Criteria/Reference Documents

The current revision of the following publications is to be used in conjunction with the design criteria in this document.

- MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS - USDOT, FHWA
- STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION and GENERAL SPECIFICATIONS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING - Construction Specifications, ADOT
- TRAFFIC SIGNALS AND LIGHTING and SIGNING AND MARKING - Standard Drawings, ADOT
- TRAFFIC CONTROL MANUAL FOR HIGHWAY CONSTRUCTION AND MAINTENANCE - ADOT
- MANUAL OF SIGNS APPROVED FOR USE ON STATE HIGHWAY SYSTEM - ADOT
- POLICIES, GUIDE AND PROCEDURE MANUAL - ADOT
- INFORMATIONAL GUIDE FOR ROADWAY LIGHTING - AASHTO
- GUIDE TO STANDARDIZED HIGHWAY LIGHTING POLE HARDWARE - AASHTO
- UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION - MAG
- UNIFORM STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION – MAG
- SCOTTSDALE SUPPLEMENT TO MAG UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION - COS
- SCOTTSDALE SUPPLEMENT TO MAG UNIFORM STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION - COS
- CITY OF SCOTTSDALE DESIGN STANDARDS AND POLICIES MANUAL

3-204 PRE-DESIGN CONFERENCE WITH STSDOD

Prior to beginning traffic signal design, a pre-design conference may be requested by either STSDOD or the design consultant.

3-205 TRAFFIC SIGNAL DESIGN GUIDELINES

All equipment and materials specified must be listed on the COS QPL or include the required documentation to comply with the COS QPL.

A. Specifcations/Provisions

1. The COS "Boiler Plate" construction specifications shall be used. The need for project-specific construction special provisions will be determined by the STSDOD. (Specifications for controllers, controller cabinets, lighting, and other equipment details is included in this document.)

B. Signal Structures

1. Poles shall be per TRAFFIC SIGNALS AND LIGHTING – Standard Drawings, ADOT, and must meet the STSDOD QPL.

2. The preferred configuration of poles is one pole per corner, located at the center of the curb return, at the back edge of the sidewalk. A sufficient landing which meets ADA requirements must be provided. Situations requiring multiple poles per corner, or poles (traffic signal or pedestrian) within medians should be discussed with the STSDOD.

3. Traffic signal installations along the east and west couplet require "trombone style" poles and mast arms.

4. Combination poles, bracket arms, mast arms, bases and foundation entrance conduit shall be included on the traffic signal plan.

C. Signals

1. All design elements must comply with MUTCD standards, unless directed otherwise by the STSDOD.

2. Twelve-inch signal faces shall be used for all overhead indications and for all left-turn indications. Eight-inch signal faces may be used within signal heads at other locations. Exceptions, such as 12-inch indications for side-mount heads where increased visibility is desired, may be recommended by the consultant and/or may be required by the MUTCD or STSDOD.

3. Typically, a minimum of three heads is required for control of a through movement (one overhead mount and two far-side, side-mounts – left and right). Typically, a minimum of two heads is required for control of other movements.

4. Typically, a minimum of two heads is required to control a left-turn movement. One head shall be overhead-mount, on the mast arm containing the heads which control the corresponding through movement, and the other head shall be side-mounted or pole- mounted on the far-side left corner, facing the corresponding through movement.

5. One mast arm-mounted signal head is required for expressway off-ramp terminals.

6. Red ball, green ball, red arrow, and green arrow indications shall be "LED" type lamps. All pedestrian indications shall also be "LED" type lamps. LEDS shall be model 430-

1315 or approved equivalent. Wattage is as follows: 8" red ball = 15 watts; 12" red ball = 15 watts; 12" red arrow = 9 watts; 8" green ball = 8 watts; 12" green ball = 11 watts; 12" green arrow = 11 watts; 16" pedestrian "man/hand" signal module = 11 watts. All amber indications shall be "Dura-Test" lamps or approved equivalent. Wattage is as follows: 8" ball = 90 watts; 12" ball or arrow = 135 watts. Questions regarding indication type should be directed to the COS, Field Services Division, (480) 312-5634.

7. Fiber optic indications shall not be used unless directed otherwise by the STSDOD.

8. Only polycarbonate signal heads and glass lenses may be used.

9. Heads and mounting brackets shall be black.

10. Back plates and tunnel visors shall be installed on all signal faces and shall be black.

11. Base-mount mounting height of 4 and 5 section heads should be adjusted to avoid conflict with mast arm. The aiming of the head can not conflict with the mast arm or mast arm connection. (These side-mount heads should be mounted on the backside of the pole, at a 45 degree angle, at a height of 115 inches.)

12. A maximum of three heads shall be installed on a mast arm that is 40 feet in length or less. A maximum of four heads shall be installed on a mast arm that is 45 feet in length or longer. (A mast arm that is 40 feet in length or less shall include a minimum of two tenons. A mast arm that is 45 feet in length or greater shall include a minimum of three tenons.)

13. The use and placement of right-turn arrow heads shall be approved by the STSDOD.

14. ADOT type eleven (XI) mounting hardware will not be used in Scottsdale signal designs.

D. Pedestrian Signals
   1. Pedestrian signals should be installed at ALL crossings, unless directed otherwise by the STSDOD.

   2. Pedestrian push-buttons should be installed at ALL crossings, unless directed otherwise by the STSDOD.

   3. Pedestrian push-buttons shall meet ADA requirements. (All traffic signal poles with pedestrian push-button assemblies shall be wheel chair accessible. A four (4) foot wide concrete access ramp and landing per ADA requirements shall be provided to poles which are not placed immediately adjacent to sidewalks. Pedestrian push-button assemblies shall be mounted no higher than 42 inches above the adjacent sidewalk or ramp elevation.)

   4. The ADOT pedestrian push-button post shall be used when necessary in accordance with MUTCD.

   5. Pedestrian signals shall be 16" LED "Man/Hand" indication and have bottom hinges.

   6. The required "Pedestrian-Push-Button-Placard" design may be viewed at www.ci.scottsdale.az.us/streets/signs&mrk.asp, or contact COS, Field Services Division, at (480) 312-5635.

E. Controller
   1. The Controller shall be a 170E or higher system unless otherwise directed by the STSDOD.

F. Controller Cabinet
   1. The controller cabinet shall be model 330 unless otherwise directed by the STSDOD.

   2. Typically, the cabinet should be located on the same corner as the power cabinet. (The power cabinet is typically located on the corner closest to the power source, which is typically specified by the power provider.) To the extent possible, the cabinet should be shielded and protected from the threat of errant vehicles. The cabinet should be positioned so as to allow a technician working within the cabinet, a clear view of the intersection under control.

   3. The cabinet foundation shall project 12 to 18 inches above the adjacent (ultimate) ground elevation. The cabinet foundation shall extend 32 to 36 inches below the adjacent (ultimate) ground elevation.

G. Electric Service Cabinet
   1. The electric service cabinet shall be "MEYERS model MUEGL-W/TB" unless otherwise directed by the STSDOD. The electric service cabinet shall include the following: lightning arrest (ground rod); photocell receptacle rated for 20 amps or more; sub-breakers; and test/auto switch. A permanently affixed metal address tag shall be mounted on the front side underneath the meter window.

   2. Typically, the electric service cabinet is located on the corner closest to the power source, which is typically specified by the power provider. To the extent possible, the cabinet should be shielded and protected from the threat of errant vehicles. The cabinet should be positioned so as to allow a technician working within the cabinet, a clear view of the intersection under control.

   3. A #7 pull box shall be installed adjacent to the electric service cabinet. A power run shall be installed from the pull box to the cabinet.

   4. When the power source is an overhead power drop, 2-inch galvanized conduit shall be used above ground and through the first underground sweep.

   5. The cabinet foundation shall project 12 to 18 inches above the adjacent (ultimate) ground elevation. The cabinet foundation shall extend 32 to 36 inches below the adjacent (ultimate) ground elevation.

   6. The service address shall be permanently attached to the electric service cabinet.

H. Loop Detectors
   1. All loop detectors shall be wire-in-duct type wire. (Detect-a-Duct or approved equivalent, #14 stranded inside a ¼ inch PVC tubing.)

   2. All loop detectors shall be centered in the middle of the applicable traffic lane. Loops shall be sufficiently dimensioned on the plans. Loop detectors should extend five feet into the crosswalk unless directed otherwise by the STSDOD.

   3. A rectangular loop with 3 turns (6 feet x 40 feet) shall be used for all through lanes.

4. A quadrapole loop with 2 outside turns and 4 inside turns (6 feet x 40 feet) shall be used in all exclusive left-turn lanes. (Wire in middle cut shall run the same direction.)

5. Loop detectors shall not be installed in exclusive right turn lanes.

6. The location of permanent count detector loops shall be specified by the STSDOD. Count detector loops shall consist of a minimum of 4 turns (6 feet x 6 feet).

7. Pre-formed loop detectors conforming to the latest ADOT specification shall be used under decorative pavement, "pavers," concrete, or other "special" roadway surfaces, or as directed by the STSDOD.

8. Lead-in cable between loop wire and controller shall meet IMSA 50-2 specification or approved equivalent.

9. Loop lead-in and splices in pull box shall be twisted and soldered. Griggs Loop Detector Sealant, 3-M Loop Sealant, or approved equivalent shall be used

10. Loops shall be installed prior to the installation of the final pavement lift (if part of a paving project).

11. Loops shall be inspected and tested prior to acceptance by the City.

I. Conductors

1. #12 solid THHN/THWN wire shall be used for all signal conductors. #12 stranded THHN/THWN wire shall be used for all pedestrian push-button conductors.

2. Signal pole and conduit grounding wire shall be #8, solid bare copper wire.

3. Belden 9883 or approved equivalent shall be used between telephone drop point and the controller. IMSA 50-2 or approved equivalent shall be used between detector-loop pull box and the controller.

4. Opticom model 138 detector cable shall be used for emergency vehicle pre-emption. 138 detector wire may not be spliced between pole connection and cabinet termination.

5. Lead-in cable between loop wire and controller shall be IMSA 50-2 specification or approved equivalent.

6. Any existing conduit run which is disturbed shall be re-pulled completely with new wire and the old wire shall be removed. The use of wire pulling lubricant is required in all conduits. Pull wires shall be installed in every conduit run.

7. No wire splicing shall be permitted, except in pull boxes, terminal compartments, control cabinet, and electric service cabinet. Wire splices must be twisted prior to wire nuts being installed. All splices shall be dipped in 3M Scotch Kote or approved equivalent a minimum of two times to eliminate any air bubbles. Wire nut shall be 100% filled with sealer. All pull box loop detector connections shall be soldered. Loop wire to first pull box shall be twisted a minimum of six wraps per foot prior to soldering to lead-in cable.

J. Conduits

1. 2-inch conduit shall be used for pole runs and telephone drop. 2 1/2-inch conduit shall be used for all other runs.

2. Two (2) 2 1/2-inch conduits are required for every street crossing.

3. Galvanized conduit shall be used for exposed, above-ground runs through the first sweep below grade.

4. Red warning tape shall be placed in all trenches, 12 inches below final grade.

5. Expansion joints shall be used every 50 feet.

6. Schedule 40 PVC shall be used, except for service runs above ground.

7. Avoid installing conduit in the medians, unless otherwise directed by the STSDOD.

K. Pull Boxes
   1. No pull boxes shall be placed in traveled roadways. Conduit must be extended where necessary to relocate pull box to a non-traveled area.

   2. Concrete pull boxes with steel covers shall be used in dirt areas and in sidewalks.

   3. When possible, pull boxes shall be located adjacent to sidewalks rather than in the sidewalk.

   4. All traffic signal pull boxes shall be marked "Traffic Signal" on the lid.

   5. Pull boxes shall be used at all corners and in island noses.

   6. #7 pull boxes shall be used in all locations except on end runs and unless otherwise directed by STSDOD.

L. Lighting
   1. Luminaires shall be provided on all signal poles unless there is a utility conflict or unless directed otherwise by the STSDOD. Luminaire wire connections shall only be made in pull boxes and not brought into the signal controller cabinet.

M. Emergency Vehicle Pre-Emption
   1. Emergency vehicle pre-emption shall be used for al directions, at all locations, unless otherwise directed by the STSDOD. Additional sensors may be necessary if approaches are offset or vision is obstructed.

   2. Opticom model 138 detector cable shall be used for emergency vehicle pre-emption. 138 detector wire may not be spliced between pole connection and cabinet termination.

   3. Opticom detector cables must be taped and color-coded.

N. Phasing Standard
   1. Intersection phasing shall be determined by the STSDOD. Left-turn phasing will operate as lag-left unless otherwise directed by the STSDOD.

2. Corresponding permitted/protected left-turn phasing shall be wired together and operate simultaneously to avoid the left-turn trap.

3. The signal controller shall be wired by an IMSA Level 2 certified signal electrician.

O. Electrical Power
   1. Contact the applicable power provider to determine source for traffic signal power and to coordinate applicable requirements.

   2. The electrical service address shall be shown on the signal plan. The address may be obtained from the COS, Records Department.

   3. The contractor must obtain an electrical service permit from the COS, One-Stop-Shop.

P. Traffic Signal System (Communications)
   1. All traffic signals shall be interconnected to the COS Traffic Signal System by means of a telephone land-line, unless directed otherwise by the STSDOD. Contact STSDOD at (480) 312-7935 for circuit number and other applicable information.

   2. Contact the applicable communications provider to determine location for telephone drop and to coordinate applicable requirements.

   3. A separate 2 inch conduit shall be installed from the point of phone service (phone drop) to the nearest pull box. Belden 9883, or approved equivalent, shall be used for the telephone run.

   4. The telephone service address shall be shown on the signal plan. The address may be obtained from the communications provider.

Q. Signing
   1. All regulatory, warning and route marker signs shall be provided with the traffic signal installation and shall be in accordance with the Manual on Uniform Traffic Control Devices. "Metro" street name signs shall be installed on signal poles per COS criteria. See Traffic Signs and Markings, Section 3.6, for details.

R. Striping
   1. All necessary striping shall be provided with the traffic signal installation and shall be in accordance with the Manual on Uniform Traffic Control Devices. See Traffic Signs and Markings, Section 3.6, for details.

S. Removal and Salvage
   1. All existing traffic signal equipment and street lights shall remain in operation until new installations are operational.

   2. Foundations shall be removed to at least 12 inches below grade, or as directed by the COS inspector.

3-206 CONSTRUCTION PLAN SUBMITTALS

Traffic signal plans shall be submitted to Project Review through the normal One-Stop-Shop process and must comply with all requirements of the COS Design Standards and Policies Manual. **Two** (2) sets of mylar signal plans are required to receive final project approval. One set will be approved and returned to the submitter; one set will be forwarded to the STSDOD.

3-207 TRAFFIC SIGNAL PLAN CONTENT

A. Plan Content

Traffic signal plans shall be developed in accordance with the requirements of the COS Design Standards and Policies Manual, Section 1, and conform with ADOT standard practices. As a general guide, the traffic signal plan layout shall be drawn at 1" = 20' scale, and shall include the following items:

1. Locate and identify ALL existing and/or proposed improvements, above and below ground, within 200' of the intersection. INCLUDE ALL UTILITIES.

2. Locate and identify ALL existing and/or proposed pavement marking and signing, include "turn-arrows" for exclusive turn lanes.

3. Locate existing vegetation (trees, etc.) which could be in conflict with any proposed equipment locations or impact required signal visibility distances.

4. Provide a "profile layout" when vertical roadway alignment may impact traffic signal visibility requirements. (1" = 40' scale for profile is acceptable.)

5. Provide bearings for each leg of the intersection when deflection is greater than 2 degrees. Provide roadway curve data if applicable.

6. Locate all traffic signal equipment (poles, controller cabinet, electric service cabinet, telephone drop, etc.) by station and offset dimension.

7. All traffic signal poles, conduits and equipment must be located within public right-of-way or easement.

8. Controller and cabinet must be type 170 system with type 330 cabinet.

9. Electric service cabinet must be MYERS, MEUGL-100TB(dual) or COS/APS/SRP approved equivalent.

10. Locate and specify source of electric service.

11. Provide address for electric service cabinet, available through COS Records Department.

12. Locate telephone drop and run conduit with communication cable back to signal controller.

13. Provide emergency vehicle signal pre-emption, using 3M Opticom optical detectors and model 138 detector cable, or approved equivalent.

14. Provide phasing diagram for initial signal operation and ultimate 8-phase operation, unless directed otherwise by the STSDOD.

15. Provide conductor schedule indicating conduit run number, conduit size, wire type/size, phase, and any other pertinent information.

16. Details of any items not covered by standards.

B. General Notes

Include the following General Notes on all COS Traffic Signal Construction Plans. Also see the COS DS&PM, Section 1, for additional notes that may also be required.

1. All traffic signal equipment and all construction in public right-of-way or in easements granted for public use shall conform to the Arizona Department of Transportation (ADOT) standard drawings and specifications, to the Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction, to the City of Scottsdale (COS) Supplement to MAG Standard Specifications and Details for Public Works Construction, and to the COS Design Standards and Policies Manual.

2. Traffic control shall conform to the City of Phoenix "Traffic Barricade Manual" and/or as directed by the City Public Works Inspector.

3. Utility locations shown are based upon the best available information. The Contractor shall contact Blue Stake at 602-263-1100 before construction and verify actual utility locations.

4. Traffic signal poles, mast arms, and service cabinets shall be painted with 2 coats white enamel paint meeting ADOT Specification Section #1002.

5. All pull boxes shall be ADOT #7 unless noted otherwise.

6. A ground rod shall be installed within the customer side of the electrical service panel and a #4 bare bond conductor attached.

7. Pavement replacement shall conform to COS Standard Detail 2200 and 2001. Sidewalk replacement shall conform to MAG Standard Detail 230.

8. “Metro Street Name Signs” shall be installed on traffic signal mast arms per COS Supplement to MAG Specifications, Section 402.3.4.

9. Applicable signal and pedestrian indications shall be “LED” type lamps pursuant to the COS Design Standards and Policies Manual.

10. Emergency Vehicle Pre-Emption shall be field-adjusted to optimize reception.

11. All existing traffic control devices (including stop signs) and street lights shall remain in operation until new installations are energized and operational. Any removed COS equipment shall be salvaged and returned to the COS Traffic Signal Shop at 9191 E. San Salvador (Scottsdale).

12. Questions concerning traffic signal design should be directed to the “Signal Designer, Address, Phone Number.”

13. The electrical service address is: XXXXXXXXXX.

14. The Telephone drop address is: XXXXXXXXXX.

15. At START of construction the contractor shall contact the COS Signal Supervisor at 480-312-5635 to coordinate power authorization, cabinet set-up and inspection requirements.

16. At START of construction the contractor shall contact the electric power provider to confirm power location and to schedule inspection.

17. At START of construction the contractor shall contact the telephone service provider to confirm telephone drop location and to schedule inspection.

C. Standard Traffic Signal Circuitry

CONDUCTORS (#)	AWG	PHASING/CIRCUIT
Signal (3)	12	01 – 08 / Controller to heads
Ped Signal (2)	12	02, 04, 06 08 Ped / Controller to ped heads
Ped Buttons (1)	12	02, 04, 06, 08 Ped / Controller to ped buttons
Signal Common (1)	12	Pole (w/ped or signal head) to controller
Ped Common (1)	12	Controller to all buttons
Spares (Minimum 3)	12 (Brown)	Any conduit crossing under roadway
Power Hot (2)	8	Electric service to controller
Street Light Common (1)	12	Electric service to all fixtures
Street Light Hot (1)	8	Electric service to fixtures
Equipment Ground Bare Bond (1)	8	In all conduit with voltages present
Electric Service Bare Bond (1)	4	From electric service to ground
Telephone interconnect (1)	Belden 9883	Controller to phone drop
Detector Loops (N)	IMSA 50-2	Controller to detector loop pull box

D. Phase Color Coding

The following table lists color coding for signal and detector wiring. Each signal phase wire shall be coded with colored tape in the pull box.

- SIGNAL 8 PHASE
  - NBLT - red & white
  - SB - yellow
  - EBLT - green & white
  - WB - blue
  - SBLT - yellow & white
  - NB - red
  - WBLT - blue & white
  - EB - green

- PEDs:
  - N / S - East side - red
  - N / S - West side - yellow
  - E / W - North side - blue
  - E / W - South side - green

- PED PUSH-BUTTONS
  Same as peds

- 2 PHASE SIGNAL:
  - N / S - red
  - E / W - green

- 2 PHASE PEDS:
  - N / S - red
  - E / W - green

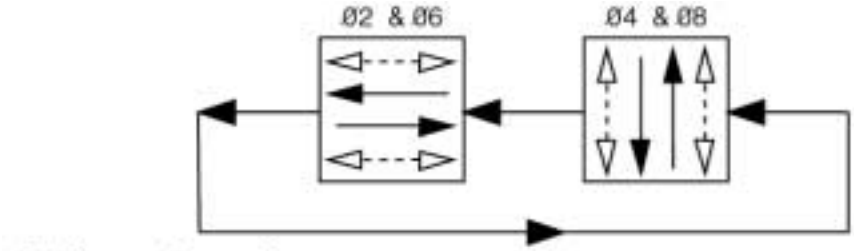
- DETECTORS
  same as signals

- PRE-EMPTION DETECTORS
  same as signals

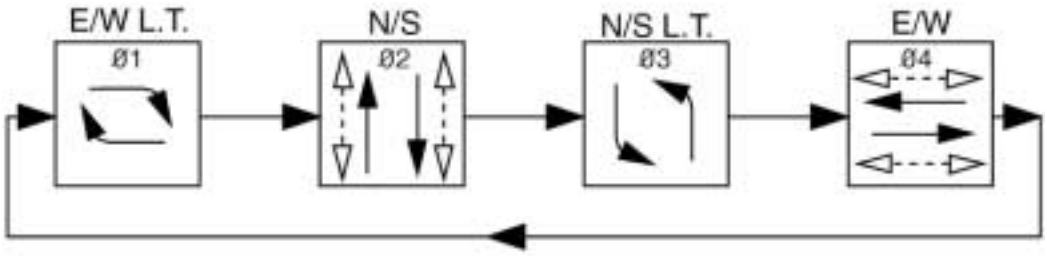
3-208 FIGURES

The following figures are included for informational purposes.

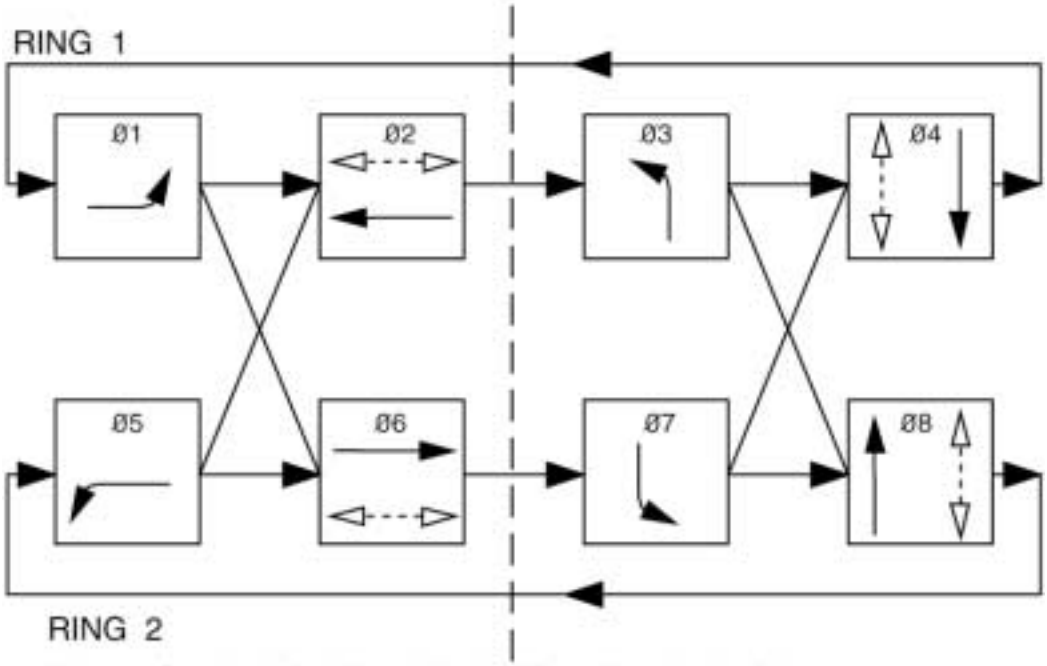
Figure 3.2-1 Phase Diagram
Figure 3.2-2 Traffic Signal Reference Chart
Figure 3.2-3 Title and Signature Block
Figure 3.2-4 Loop Detail
Figure 3.2-5 Sample Standard Traffic Signal Plan



2 Phase Operation



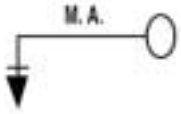
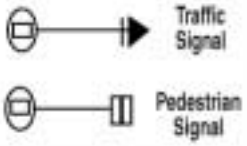
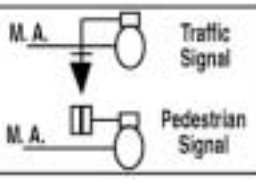
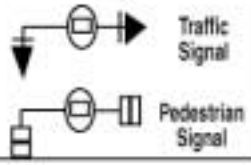
4 Phase Lag - Left Operation

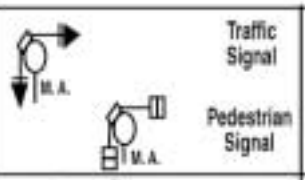
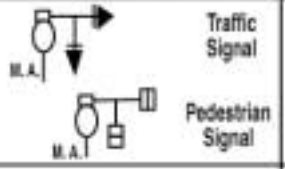
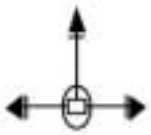
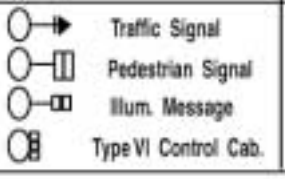


8 Phase Quad Left - Turn Dual Ring (Lead - Left)

FIGURE 3.2-1

Phase Diagram

TYPE	PLAN SYMBOL	REFERENCE
I II		ADOT T.S. 9-1
III		ADOT T.S. 9-2
IV		ADOT T.S. 9-2
V		ADOT T.S. 9-3
VI		ADOT T.S. 9-4

TYPE	PLAN SYMBOL	REFERENCE
VII		ADOT T.S. 9-5
VIII		ADOT T.S. 9-6
IX		ADOT T.S. 9-7
X		ADOT T.S. 9-8
XI		ADOT T.S. 9-9

Standard Signal Faces
Reference ADOT T.S. 8-1

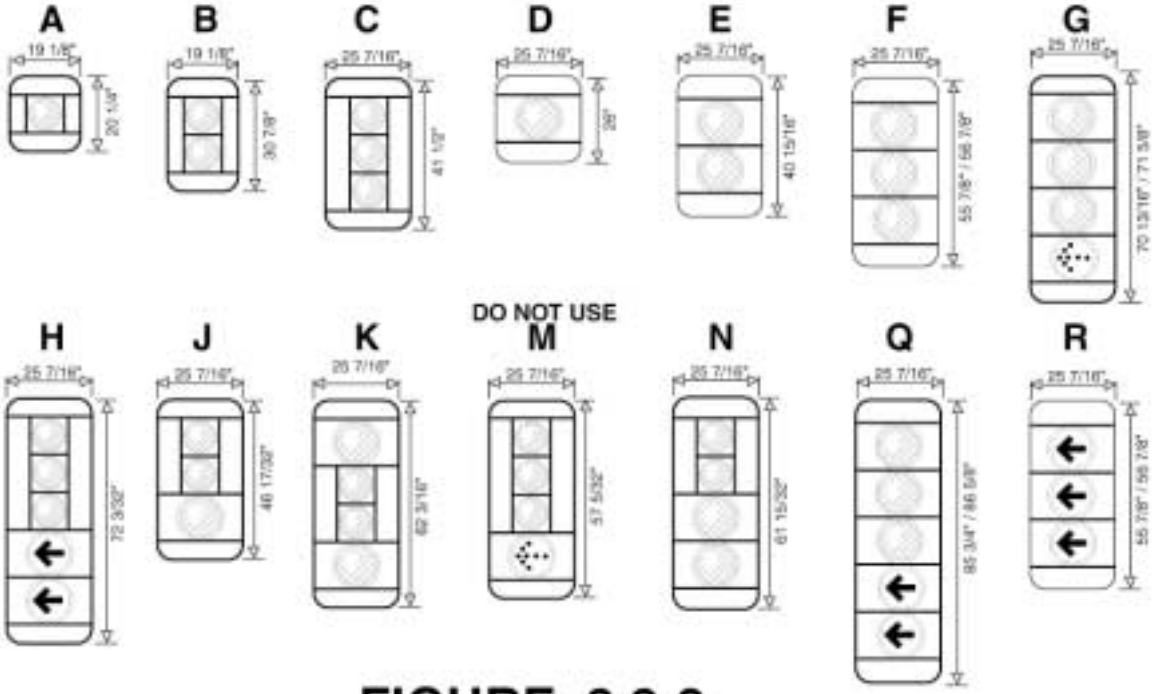


FIGURE 3.2-2

Traffic Signal Reference Chart

DATE	REVISION	BY
PROJECT TITLE		
ENGINEERING FIRM	DESIGNED BY	DRAWN BY
DATE	AS-BUILT DATE	BID NO.	SCALE	Sht. ___ of ____
ENGINEER STAMP		

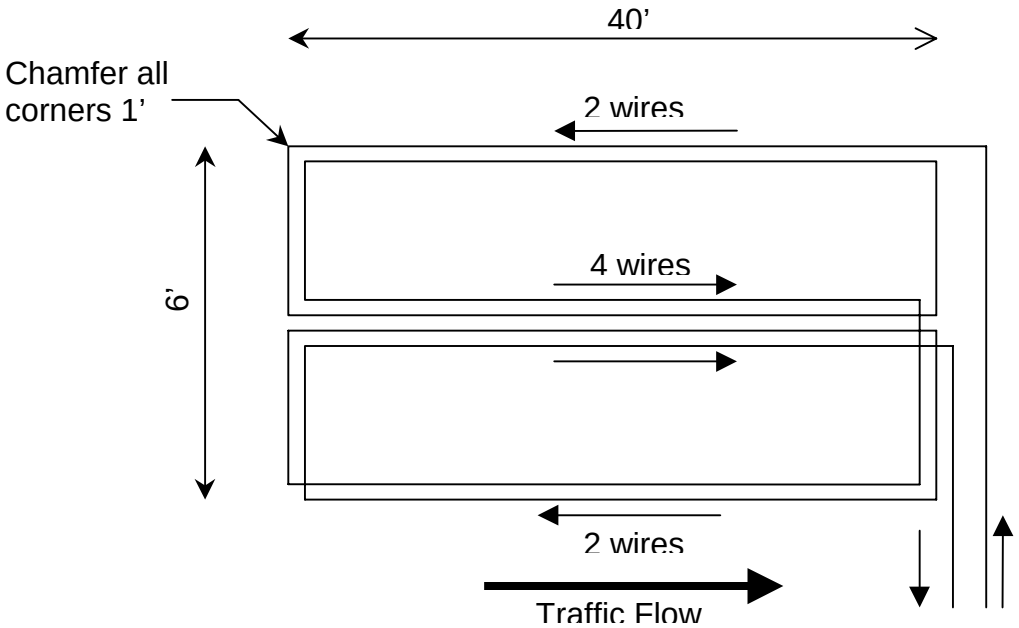
TRANSPORTATION DEPARTMENT

TRAFFIC ENGINEERING
7447 E INDIAN SCHOOL
SCOTTSDALE, ARIZONA 85251

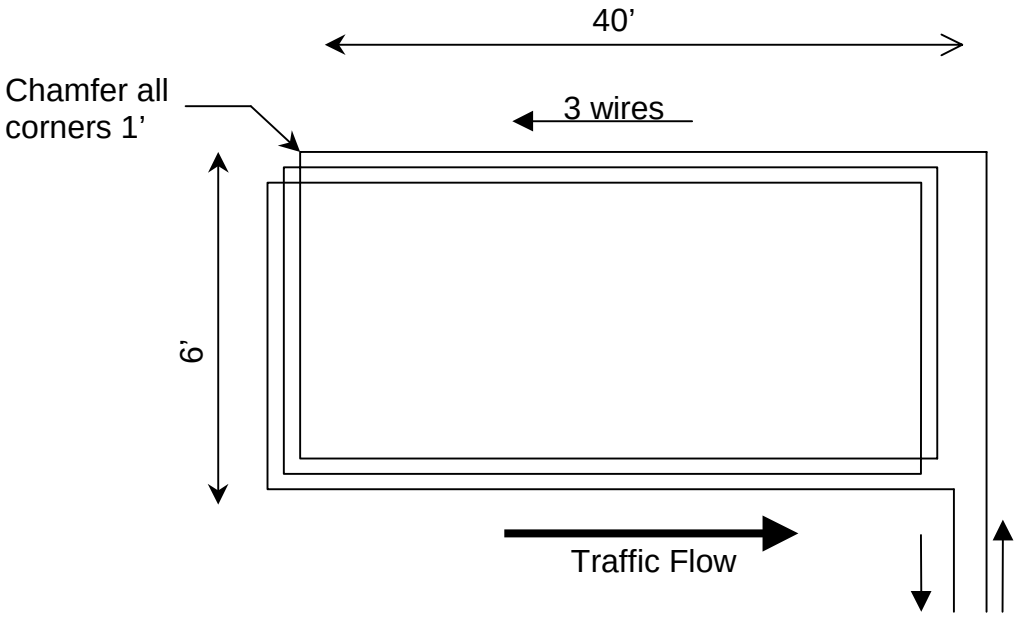
REVIEW AND SIGNATURE/DATE BLOCK

Engineering Coordination Manager (or designee)	Engineering Review

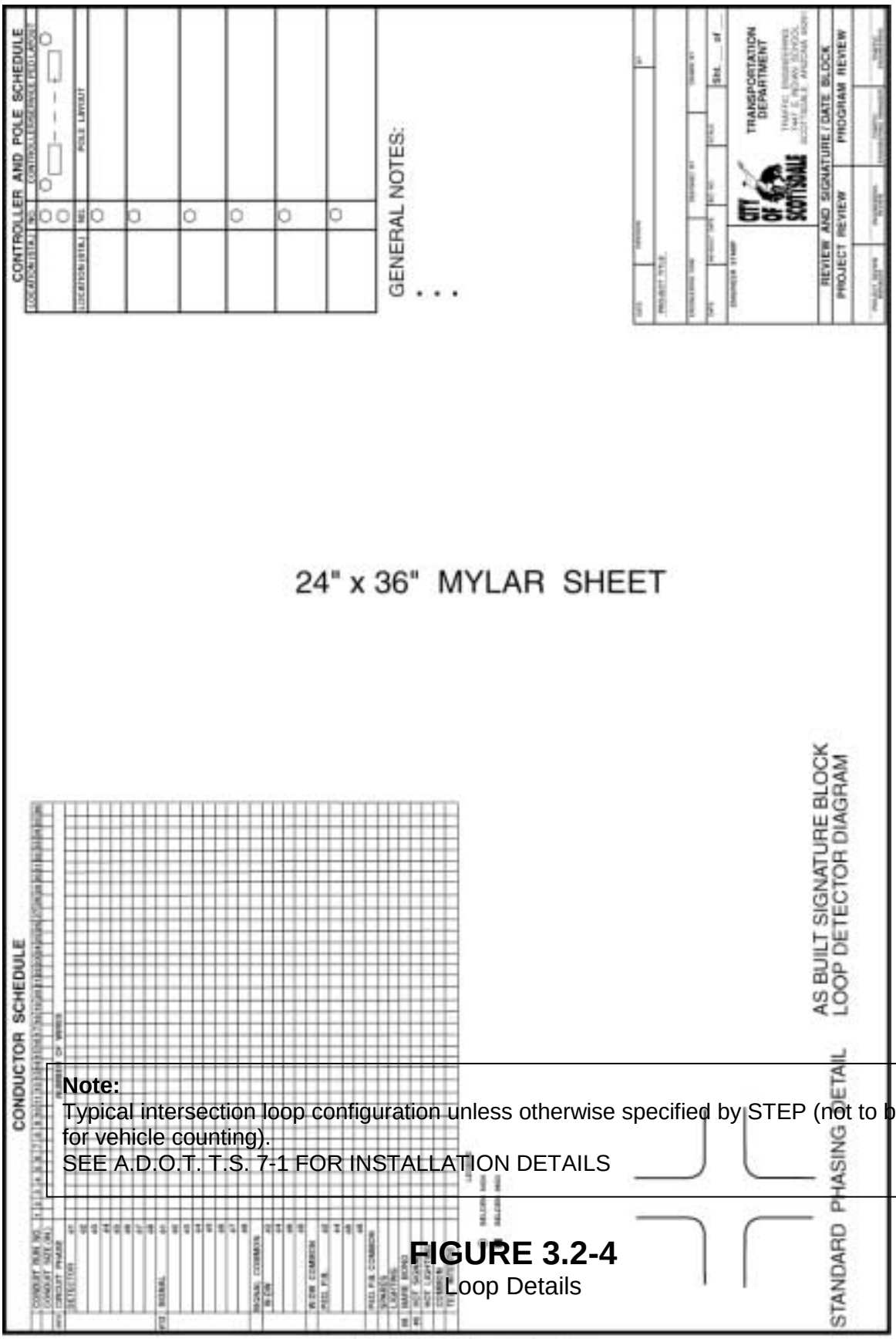
FIGURE 3.2-3
Title & Signature Block



QUADRUPOLE LOOP DETECTOR
For Left Turn Lanes Only



STANDARD LOOP DETECTOR



Note:
Typical intersection loop configuration unless otherwise specified by STEP (not to be used for vehicle counting).
SEE A.D.O.T. T.S. 7-1 FOR INSTALLATION DETAILS

FIGURE 3.2-4
Loop Details

FIGURE 3.2-5
Standard Traffic Signal Plan

3-209 GENERAL REQUIREMENTS/SPECIFICATIONS

A. All traffic signals and lighting equipment, in addition to meeting the requirements of this specification, shall conform to the current version of the following documents.

- Arizona Department of Transportation, Standard Specifications for Road and Bridge Construction
- Arizona Department of Transportation, Traffic Signals and Lighting, Standard Drawings
- California Department of Transportation, Traffic Signal Control Equipment Specifications
- International Municipal Signal Association, Wire and Cable Specifications
- National Electrical Manufacturers Association, Traffic Control Systems, Standards Publications
- U.S.D.O.T./F.H.W.A., Manual on Uniform Traffic Control Devices
- American Association of State Highway and Transportation Officials, Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals
- U.S.D.O.T./F.H.W.A., Type 170 Traffic Signal Controller System - Hardware Specification

B. Lighting Specifications
Intersection lighting shall be, 120 volt, 250 watt, two door, 90-degree cutoff with filter. GE model M 250 or ITT model 25-5232DJ, or approved equivalent, per specifications. Luminaires shall include one solid state photocell for each luminare. All wire to the installation shall be THHN/THWN or approved equal.

C. Electric Service Cabinet
Use approved alternate with lighting arrest installed. Photocell receptacle should be rated for 20 amps. Install "Grounding Rod" within the customer side of the electric service cabinet.

3-210 TYPE 170 TRAFFIC SIGNAL CONTROLLER ASSEMBLY

A. General

1. Definition: The Type 170 traffic signal controller assembly is defined as a complete electrical mechanism mounted in a cabinet for the purpose of controlling the operation of a traffic control signal.

2. General Requirements
   Qualified Products List (QPL):
   A City qualified Products List has been established for the following traffic signal controller assembly components:

   Type 170 system cabinets
   Type 170 controller units
   Remote control units
   Type 170 controller unit software

   Model 200 load switch
   Model 204 flasher
   Model 210 conflict monitor
   Model 222 two-channel loop detector
   Model 224 four-channel loop detector
   Model 242 two-channel DC isolators
   Model 252 two-channel AC isolators
   Model 430 relays
   Model 412 program module
   Model C424 and C422 count loop detectors
   See Appendix A

   City qualified vendors are not required to submit equipment for testing; however such vendors are required to submit product data including manufacturer, description, and photos.

   All vendors wishing to submit bids for traffic signal controller assembly components that are not on the City's qualified Product List, but are already on California's Qualified Product List must provide their equipment and supporting documentation for city review. If the product satisfies review process, it will be placed on the city QPL.

   Bids submitted without equipment and supporting documentation will be deemed non-responsive and WILL NOT BE OPENED. Review process will consist of 30 days for equipment testing plus 15 days for data review. Vendor is responsible for product during review process.

3. Product Training
   The contractor shall provide complete instructions in the operation of the type 170 traffic signal controller assembly component if requested by the city. This training may be in person or on videotape.

4. Proprietary Parts
   When proprietary electrical parts are used, an additional ten (10) percent inventory of the proprietary parts are to be supplied as spare parts. In addition, the contractor shall supply ordering information for the proprietary parts.

5. Product Documentation
   All data submittals required by Caltrans (i.e. warranties, diagrams, and manuals) shall be supplied to the City.

6. Equipment Warranty
   Each item furnished shall be warranted by the supplier against all defects in design, materials, and workmanship for a period of 18 months following the acceptance by the City. This guarantee period shall be extended by the amount of time between the city's notice to the contractor of a defect in the equipment and the contractor's replacement or repair of said equipment and return of said equipment to the City.

7. Hardware
   If a malfunction in any one or more of the Type 170 traffic signal controller assembly components occurs during the warranty period, the supplier shall, within 72 hours after verbal notification (excluding Saturday, Sunday and Holidays) furnish a like component for city use while the warranted unit is being repaired. The isolation of any malfunction and repair and/or replacement of any devices within the warranty period shall be the responsibility of the supplier. After the supplier has repaired and returned the operational equipment, the city will return the spare component. All costs incurred in warranty work, with the exception of city labor, is the responsibility of the contractor.

8. Software
   If a malfunction in the software occurs during the warranty period, the supplier shall within seven calendar days after verbal notification correct the problem to the city's satisfaction.

9. Note: Failure to comply with warranty requirements shall be sufficient ground to prohibit the contractor from bidding on future City contracts.

10. Software Update
    The supplier shall furnish, free of charge, all software updates to the City for a period of two years following the date of acceptance. After this time, the City requests that the contractor notify the City of all updates.

B. Type 170 TSCA Base Specifications
   The base specification for the Type 170 traffic signal controller assembly is the State of California, Department of Transportation's Traffic Signal Control Equipment Specifications, Current, including all addendums as of 30 days prior to the bid opening. Using the Caltrans specification as a foundation, the city has accepted some modified specifications. Please examine the various component descriptions for possible deviations from the "base" Caltrans specification.

C. Type 170 TSCA, Component specification - System Cabinets

1. The type 170 system cabinet is defined in accordance with Caltrans Specification as including the following:

   - housing
   - mounting cage
   - power distribution assembly (exception to Caltrans specification: field output Signal Bus Circuit Breakers must be 20 amps)
   - input files
   - power supply assembly

- output files
- C1 harness (shall be of adequate length so that controller may be removed to top of cabinet without disconnection)
- service panel
- input panel

2. Emphasized and additional minimum requirements for each Type 170 system cabinet are:

   (1) Model 210 "modified" conflict monitor
   (1) Internal, rear, florescent lamp for model 336 "stretch"
   (4) Model 430 flash transfer relays for model 330 and 336 "stretch" cabinets
   (2) Model 204 "modified" flasher unit for model 330 and 336 "stretch" cabinets
   (1) Set of cabinet anchor bolts

   The housing shall be painted white inside and outside per ADOT specifications.

3. Note:
   All Type 170 system cabinet models shall include C2 cable interface wiring, plus PC 642C-008 telephone surge arrestor and cable to accept Model 400 modems, or approved equal. C2 cable shall be a minimum of 6 feet long. Cabinet must also include loop detector surge suppression device SR1-6LCB or approved equal (5 per cabinet).

4. Acceptable Type 170 system cabinet models are as follows:

   Model 330: New York State Department of Transportation, Traffic Signal Equipment Microcomputer Specifications current. In addition, must have flash sense wired to PDA 1/A/W latest drawing number.

   Additional requirements for each type cabinet include phone jack installed in police panel with 5 feet twisted pair wire connected in accordance with latest drawing number.

D. Type 170 TSCA, Component specification Model 170 Controller Unit

   NOTE: 170 controller units must be able to accept dual port ACIA, and modem (C2 & C20) shall be complete and functional.

E. Type 170 TSCA, Component Specification Model 412 Program module "modified."

   Additional requirements for the Model 412 "modified" program module are:

   - Each program shall be capable of running the traffic signal control program currently used by the city. (WAPITI MICRO SYSTEMS CORP., W4IKS, current revision).

   - The contractor shall supply a fully programmed configuration PROM. The city will program the 27256 EPROM with the current revision of W4IKS. The contractor shall supply two 6264 RAMS and two 2816 EEPRMS or 32K or higher non-volatile storage RAM as required.

F. Type 170 TSCA, Component Specification Model 200 Load Switch Module "modified."

Additional requirements for the Model 200 "modified load switch module are:

- Each load switch module shall be rated at 15 amps or 20 amps.

F1: In addition, each load switch shall contain 3 replaceable "cube type" solid state modules.

G. Type 170 TSCA, Component Specification Model 204 Flasher Unit Module "modified."

Additional requirements for the Model 204 "modified" flasher unit module are:

- Each flasher unit module shall be rated at 15 amps or 20 amps.

G1: In addition, each flasher unit shall contain 2 replaceable "cube type" solid state modules.

H. Type 170 TSCA, Component Specification Model 210 Conflict Monitor "modified."

Additional requirements for the Model 210 "modified" conflict monitor are:

- Each conflict monitor shall have the ability to detect the following error conditions:
  - Simultaneous sensing of active yellow and green inputs on a channel.
  - Simultaneous sensing of active red and green inputs on a channel.
  - Simultaneous sensing of active yellow and red inputs on a channel.
  - Absence of a signal on a channel.
  - Simultaneous sensing of 2 or more active inputs for less than 750ms shall not cause the monitor to activate.
  - Simultaneous sensing of 2 or more active inputs for more than 1000ms shall cause the monitor to activate.

I. Type 170 TSCA, Component specification Model 222 "modified" - Category 1.

Additional requirements for the Model 222 "modified" vehicle detector are:

- Each detector unit shall sequentially energize its loop inputs to eliminate cross talk.

- Each channel shall retune and detect properly, immediately following reconnection of the broken (open) circuit. Previous "open" loop/lead-in connections shall be held in memory for recall and verification via a front panel "open loop test" switch.

- Each detector unit shall use the ΔL thresholding technique.

I1: Type 170 TSCA, Component specification Model 222 "modified" - Category 2:

All requirements apply except detector unit may or many not have a front panel "open loop test" switch for recall verification of previous "open" loop conditions.

J. Type 170 TSCA, Component Specification Model 224 Four Channel Vehicle Detector Unit "modified."

Additional requirements for the Model 224 "modified" vehicle detector are:

- Each detector unit shall sequentially energize its loop inputs to eliminate cross talk.

- Each channel shall retune and detect properly, immediately following reconnection of the broken (open) circuit. Previous "open" loop/lead-in connections shall be held in memory for recall and verification via a front panel "open loop test" switch.

- Each detector unit shall use the ΔL thresholding technique.

J1: Type 170 TSCA, component specification Model 222 "modified" - Category 2: All requirements apply except: detector unit may or may not have a front panel "open loop test" switch for recall and verification of previous "open" loop conditions.

K. Type 170 TSCA, component specification Model C422 or C424 - category 1 or 2: These detector units will be supplied when count loop detectors are called for on the Traffic Signal Construction Plans. The vehicle detector shall have communication capabilities via direct connection to a laptop computer or modem interface from the front panel of the detector to allow for the following functions:

- Read and send data from the communication device to the detector;

- View and change detector parameters via the communication device or switches on the detector board;

- View a currently active loop detector via communication device without disruption of operation to the controller;

- Use software utilities to test front panel indications, reset loop detectors, set communication parameters.

When more than 2 lane count detectors are called for on the signal print(s), contractor shall supply a four-channel loop detector for each direction. Two channel detectors shall be supplied for 2 loops or less per direction.

L. Type 170 TSCA, Component Specification Model 242 Two-Channel DC Isolator.

M. Type 170 TSCA, Component Specification Telemetry Unit.

1. Description:

The telemetry unit module 400 modem must have input/output connections as follows:

EDGE CONNECTOR

NAME	ORIGIN	PIN NO.	FUNCTION
DR (data receiver)	TELCO	2	Modulated data input to modem (4-wire only)
DRR (data receiver return)	TELCO	3	Return circuit for received data (4-wire only)
DX	TELCO/ MODEM	X	Modulated data input and output (2-wire) or modulated data output (4-wire)

DXR (data transmitted return)	TELCO/ MODEM	Y	Reference for DX
BA (received data)	MODEM	M	Demodulated digital data output to terminal
BB (received data)	MODEM	P	Demodulated digital data output to terminal
CA (request to send)	TERM	L	Signals the modem that the terminal wants to transmit
CB (clear to send)	MODEM	N	Flags the terminal that the modem is ready to transmit
CF (carrier detected)	MODEM	K	Flags the terminal that the modem is ready to transmit.
CF (carrier detected override)	USER	H or J	Allows the user to squelch
		Jumper Opt.	CF flag (regardless of the state of the CA signal) for 7.5=/-1 milliseconds
+12VDC	USER	C & D	Modem positive power source
-12VDC	USER	E & F	Modem negative power source
Ground, AA, BB	USER	A & B	Modem power and signal circuit common

2. Performance Specification:

Data Rate:
0-1200 baud. 1200 to 1800 baud requires user supplied conditioned lines.

Modulation:
Phase coherent FSK (frequency shift keying)

Data Format:
Asynchronous, serial.

Line interface:
Common carrier, 4 or 2-wire leased unconditioned line. For 1800-baud application use C-2 conditioned line, no distance restrictions. For unterminated dry “private wire” the maximum distance 10-20 miles depending on the line characteristics.

Line impedance:
600 ohms resistive. Others available as a factory option.

Receiver dynamic range:
+3 to –45 dBm minimum.

Carrier threshold:
-47 + / - 2 dBm at 25 degrees centigrade; maximum hysteresis is 3 dBm.

Receive frequencies:
Mark 1200 Hz, Space 220 Hz.

Receive frequency accuracy:
+ / -25 Hx for –40 dBm minimum.

Receiver performance:
Less than 15% peak jitter and 10% peak distortion at 1200-baud operation.

Transmit frequencies:
Mark 1200 Hz + / -1%, space 2200 Hz + / -1%

Transmit level:
0 dBm to –8 dBm minimum range, adjustable by potentiometer.

Data interface:
Meets EIA RS-232-C and CCITT V.24/.28 standards.

Indicators (LEDs):
Transmitted data, received data, carrier detect, request to send, clear to send.

Operating temperature:
-40 to +75 degrees centigrade.

Timing specifications:
CTS Timing: 12 + / -2mS, Rec. line signal director: 8 + / -2mS on/off, Carrier turnoff: 10 ms nominal.
Power requirements:
+12 VDC, 75mA maximum; -12 VDC, 75mA maximum; maximum noise ripple, 500 mV.

Mode selection:
(via PC board switches)
2-wire Half Duplex; 4-wire Full Duplex.

Connector:
Printed circuit board edge connector; two rows of 22 bifurcated contacts on 0.156 inch center (44 pins). Polarity keyed between pins C & D and pins H & J.

3. General Requirements:
   Qualified products list (QPL):

   a. A City of Scottsdale QPL has been established for traffic signal structures. See Appendix A. Qualified product contractors are not required to submit documentation for review by the city. All contractors wishing to submit bids for traffic structures that are not on the QPL must provide documentation for City review in advance of their bid submittal. Bids submitted without product documentation will be deemed non-responsive and WILL NOT BE OPENED.

      All contractors bidding traffic signal structures not on the City QPL are required to submit the following documentation for the city's review:

      - Traffic signal structure drawings.
      - Traffic signal structure specifications.

- Traffic signal structure load calculations signed and stamped (based on the maximum city loading).
- Documentation of all deviations from ADOT specifications.
- A letter signed and stamped by a registered professional engineer stating that the signal structure will safely support the maximum loading as described by the City.
- Recommended foundation designs and specifications for all traffic signal structures except the ADOT/Scottsdale traffic signal structures.

b. Traffic Signal Structures ADOT/Scottsdale
The base specification and warranty requirements for the ADOT/Scottsdale traffic signal structure shall be:

Arizona Department of Transportation, Standard Specification for Road and Bridge Construction: Current.

Arizona Department of Transportation, Traffic Signals and Lighting, Standard Drawings: Current.

3-211 TRAFFIC SIGNAL STRUCTURES

A. General

1. Definitions: A traffic signal structure is defined as a complete pole and mast arm assembly attached to a concrete foundation for the purpose of supporting traffic signals, street lights, and signs.

The traffic signal structure shall as a minimum consist of the following parts:
- pole shaft
- signal mast arm
- luminary mast arm (if required)
- foundation anchor bolts plus hardware
- mast arm pole connecting hardware
- top cap hardware
- pole hardware
- concrete foundation and steel reinforcing (if required)
- protective coating

2. General Requirements
Qualified Products List (QPL):

A City of Scottsdale Qualified Products List has been established for traffic signal structures. See Appendix A. Qualified product contractors are not required to submit documentation for review by the city. All contractors wishing to submit bids for traffic structures that are not on the Qualified Products List, must provide documentation for City review in advance of their bid submittal. Bids submitted without product documentation will be deemed non-responsive and WILL NOT BE OPENED.

All contractors bidding traffic signal structures not on the City QPL are required to submit the following documentation for the City's review:
- Traffic signal structure drawings
- Traffic signal structure specifications
- Traffic signal structure load calculations (based on the maximum city loading) signed and stamped

- Documentation of all deviations from ADOT specifications
- A letter signed and stamped by a registered professional engineer, stating that the signal structure will safely support the maximum loading as described by the city
- Recommended foundation designs and specifications for all traffic signal structures, except the ADOT/Scottsdale traffic signal structures

B. Traffic Signal Structures ADOT/Scottsdale
The base specification and warranty requirements for the ADOT/Scottsdale traffic signal structure shall be:

Arizona Department of Transportation, Standard Specification for Road and Bridge Construction: Current.

Arizona Department of Transportation, Traffic Signals and Lighting, Standard Drawings: Current.

3-212 TRAFFIC COUNTER COMPONENTS

A. General
1. Definition:
A traffic counter is defined as a complete, portable, microprocessor based system, to be used for the primary purpose of counting motor vehicles. There are two types of traffic counters--a Type 1 System and a Type II System. Each system is comprised of three major components:

- A field unit
- A set-up, monitor and data collection system
- Count data management software

2. General Requirements
Qualified Products List (QPL):
A City of Scottsdale Qualified Products List has been established for traffic counters (see Appendix A). Qualified product contractors are not required to provide equipment for testing.

3. Product Documentation:
The contractor shall include three sets of complete technical information, shop drawings, circuit diagrams, instruction manuals, and all other necessary documents to fully describe the field unit and the set-up, monitor and data collection system.

4. Product Training
The contractor shall provide complete instruction in the operation of the field units, the set-up, monitor and data collection system, and the count data management software. This training may be in person or on videotape.

5. Proprietary Parts:
When proprietary electrical parts are used, an additional ten (10) percent inventory of the proprietary parts are to be supplied as spare parts. In addition, the contractor shall supply ordering information for the proprietary parts.

6. Equipment Warranty:
   Each item furnished shall be warranted by the supplier against all defects in design, material, and workmanship for a period of 18 months following the acceptance by the City. This guarantee period shall be extended by the amount of time between the City's notice to the contractor of a defect in the equipment and the contractor's replacement or repair of said equipment and return of said equipment to the city.

7. Hardware:
   If a malfunction in any one or more of the field units, or the set-up, monitor and collection system, occurs during the warranty period, the supplier shall, within 72 hours after verbal notification (excluding Saturday, Sunday and Holidays) furnish a like component for city use while the warranted unit is being repaired. The isolation of any malfunction and repair and/or replacement of any device within the warranty period shall be the responsibility of the supplier. After the supplier has repaired and returned the operational equipment, the City will return the spare component. All costs incurred in warranty work, with the exception of city labor, is the responsibility of the contractor.

8. Software:
   If a malfunction in the software occurs, the supplier shall within seven calendar days after verbal notification correct the problem to the City's satisfaction.

   Note: Failure to comply with warranty requirements shall be sufficient ground to prohibit the contractor from bidding on future city contracts.

9. Software Updates:
   The supplier shall furnish, free of charge, all software updates to the city for a period of two years following the date of acceptance. After this time, the city requests that the contractor notify the city of updates.

10. Completeness:
    Each Type 1 and Type 2 traffic counter system field unit shall be complete and fully operational, with the exception of the in-road loops and tubes. All components needed for full operation shall be provided by the contractor. This is to include but not be limited to:

    - Memory packs, data modules, or other types of data storage cartridges
    - Batteries
    - Electrical cables and connectors

    Each Type 1 and Type 2 traffic counter system, set-up, monitor and data collection system shall be complete and fully operational. All hardware and software necessary to accurately and efficiently perform the specified operations shall be included.

B. Traffic Counter Type 1 System Field Unit Functional Specification:
   The purpose of the Type 1 system field unit is to count and classify motor vehicles by speed, length, type and gap using tube or loop type vehicle detectors. As a minimum, the Type 1 system field unit shall have the following:

   Vehicle detection: 2 air switches, 8 internal, inductive loop detectors

   Programmable recording intervals: 5 minute, 15 minute, 30 minute, 1 hr, 12 hrs, 24 hours

Maximum count rate: 10 counts per second, 100 vehicles per minute
9,999 vehicles per count period

Clock: 24 hour, real time, accurate to within 5 minutes per month

Calendar: Full year - month - day

Data transfer: Electronic

Housing: Aluminum or steel and weather resistant

Power: Battery(s)

C. Traffic Counter Type 2 Field Unit Functional Specification
The purpose of the Type 2 system field unit is to count motor vehicles using tube type vehicle detectors only. As a minimum, the Type 2 system field unit counter shall have the following:

Vehicle detection: 2 air switches

Programmable recording intervals: 5 minute, 15 minute, 30 minute, 1 hr, 12 hrs, 24 hours.

Maximum count rate: 10 counts per second, 100 vehicles per minute
9,999 vehicles per count period

Clock: 24 hour, real time, accurate to within 5 minutes per month.

Calendar: Full year - month - day.

Data transfer: Electronic

Housing: Aluminum or steel and weather resistant.

Power: Battery(s)

D. Traffic Counter Type 1 and Type 2 Systems Set-Up

1. Functional Specification

Minimum requirements:
The purpose of the setup, monitor and data collection system shall be to perform the following tasks:

a. Initialize and program into the field unit the count data collection parameters.

b. Verify that the field unit is operating properly.

c. Extract traffic counts from the field unit and transfer the data to a city printer or a city IBM PC/XT/AT compatible computer.

The set-up and monitor system may use any one of, or a combination of the following methods to accomplish the described tasks a and b:

1. The field unit's RS232 communications port and a (*) portable computer.

2. The field unit's keyboard and display or a programmer.

3. A data shortage module inserted into the field unit along with the field unit's keyboard and display.

The data collection system may use any one of, or a combination of the following methods to accomplish the described task c:

1. In the field, up-load the count data via the field unit's RS232 communications port to a (*) portable computer. In the office, data is transferred from the portable computer to a city printer or city computer.

2. In the field, up-load the count data from the field unit to a data storage module. In the office, the data is transferred from the data storage module via a field unit to a city computer.

3. In the field, up-load the count data from the field unit to a data storage module. In the office, the data is transferred from the data module via a communications interface device to a City computer.

*Note: If the contractor can only manipulate data in the field by method number 1, then the contractor shall supply a small rugged portable computer as part of the set-up, monitor and a data collection systems. The portable computer shall be constructed to withstand the potential of high impact and vibration associated with field use.

E. Traffic Counter Type 1 and Type 2 Systems Count Data Management Software

Minimum requirements:
The count data management software shall be designed to operate in conjunction with an IBM PC/XT/AT compatible computer system. The purpose of the program is to arrange the volume, speed, type, length, and gap data into meaningful formats, produce understandable reports, and store data files.

3-213 OPTICALLY ACTIVATED TRAFFIC SIGNAL PHASE SELECTION SYSTEM SPECIFICATIONS FOR AN EMERGENCY VEHICLE PRIORITY SYSTEM

A. System Description
The system employs optical communication to identify the presence of designated priority vehicles and cause the traffic signal controller to advance to and/or hold a desired traffic signal display selected from phases normally available. The matched set of components, which make up the system, will cause the existing traffic controller to be manipulated upon recognition of the signal from the vehicle. This communication is effective to the optical detectors at or near the intersection over a line-of-sight path of a minimum of 1,800 feet. The system shall require no action of the vehicle operator other than the operation of the "Emitter On" switch located in the vehicle. The switch is to remain "ON" until the end of the emergency run. The system shall operate on a first-come first-served basis or on selected priority basis. The system shall be designed to yield to other priority demands such as railroad, drawbridge, etc. The system shall interface with existing traffic signal controllers without compromising normal operation or existing safety provisions. The Priority control System shall consist of an optical emitter, optical detectors, optical detector cable, and phase selectors.

B. Matched System Components

To assure desired performance, the system, shall provide the synergy of four principle components, matched and proven through integrated testing and extensive functional experience. The matched component system shall offer compatibility with all types of traffic signal controllers, i.e., electro-mechanical, solid-state. Matched components provide future system compatibility of all priority control elements.

1. Optical Emitter (not part of signal design)
   Shall be a lightweight, weatherproof, light-emitting device with internal, regulated, power supply designed to produce high intensity optical energy, from a single source, precisely timed by a crystal controlled circuit.

2. Optical Detector
   Shall be a lightweight, weatherproof, adjustable, bi-directional optical detector assembly. Internal circuitry shall transform optical energy from the optical emitter assembly into electrical signals for delivery (up to 1,800 feet) via optical detector cable to the phase selection equipment.

3. Optical Detector Cable
   Shall be a durable, shielded, 3-conductor cable with a drain wire and the necessary electrical characteristics to carry power to the optical detector from the phase selector and to carry the optical detector signal to the phase selector.

4. Phase Selector
   This equipment shall interface between the optical detectors and the controller unit and provide the following functions while not compromising the existing fail-safe provisions.

   a. Sufficient power to all optical detectors required for the intersection.

   b. Suitable sensitivity to the optical detector signal via adjustable range potentiometers.

   c. Differentiation of signals by optical detectors from one or more emitters on a first-come, first-served basis.

   d. Outputs to signal the controller to cause selection of the desired phase green display for the approaching vehicle.

   e. Smooth transition to non-priority operation upon passage of the vehicle through the intersection.

   f. Various phase selector models that take advantage of the phase delivery capability of the variety of traffic controller types.

C. System Operation

1. Phase selection shall be activated by an optically transmitted signal of 14.035 or 9.639HZ from a single light source, or upon the actuation of a test switch or remote call signal to the phase selector.

2. The system shall cause the traffic controller to select from normally available green phases by activation of a combination of its inputs such as STOP TIME, MANUAL,

FORCE OFF, MANUAL CONTROL ENABLE, INTERVAL ADVANCE, PHASE OMIT, and VEHICLE DETECTOR;
or
by activating one of several discrete inputs that will cause the controller to execute one of its internal programmable priority phase selection plans.

3. The system shall not require modification or replacement of the existing traffic controller unit beyond adding the necessary system hardware.

4. The system shall provide adjustable timing capability to ensure adequate minimum traffic signal displays when priority control is active. The traffic engineer shall be able to establish the following within the limitations of the traffic controller unit and the timings stated in section IV.D of this specification:

   a. Minimum green times on non-designed greens.

   b. Minimum display times of pedestrian WALK and DON'T WALK.

5. The system shall provide for up to 3 optical detectors to be connected to each channel to accomplish the following:

   a. To provide adequate optical emitter detection range to allow sufficient time to deliver the desired traffic signal display in accordance with the minimum times required to terminate non-desired traffic signal displays.

   b. To provide continuous line-of-sight contact between the optical emitter and the optical detector units.

6. Abnormal sequence of traffic signal displays will not occur.

7. Transitions from green to red without an appropriate yellow change interval will not occur.

   The system shall cause the controller to deliver the desired traffic signal display even if the optical energy signals are interrupted before the desired display is obtained. This "commit to green" feature may be provided by the priority system or the traffic controller's software.

8. The system shall allow the traffic signal controller to resume normal timing operation after the desired signal display is obtained and optical signals have ceased for an appropriate period.

9. The system shall not attempt controller manipulation nor retain priority vehicle calls during periods of "Intersection Flash" operation.

D. System Component Specifications

1. Optical Emitter (not for signal design)

   a. The optical emitter shall include an optical energy emitting unit and emitter control.

   b. The optical emitter shall operate over an ambient temperature range of -30OF (-30OC) to up to +140OF (+60OC).

c. The optical energy emitting unit shall contain an internal, regulated power supply to convert 12VDC (positive or negative ground) vehicle battery power to high voltage required for the flashtube and meet the following electrical requirements:

- Operate at 10 to 15 volts DC.
- Have internal protection for sustained input voltage up to 25 volts DC.
- Deliver sufficient optical energy to activate the optical detector up to 1,800 feet (549m).
- Power consumption of less than 40 watts.
- The optical emitter shall weigh not more than 4.5 lbs. (9.9kg).
- The optical emitter shall produce precisely timed pulses of high intensity light from a single light source.
- The optical emitter shall be controlled by a single ON/OFF switch, which requires no warm-up, setting, or adjustments by the vehicle operator.
- The emitter shall produce crystal controlled optical energy pulses at a rate of 14.035+/-255HZ or 9.639+/-.199Hz.

2. Optical Detector

a. The optical detector shall be a lightweight, weatherproof device capable of sensing and transforming pulsed optical energy into electrical signals usable by the phase selection equipment.

b. The unit shall be high-impact polycarbonate construction with non-corrosive hardware.

c. The unit shall be designed for simple mounting at or near an intersection on mast arm, pedestal, pipe, or span wire.

d. The unit shall accept optical signals from two directions and provide a single electrical output signal.

e. The unit shall include a design feature to allow aiming of the two optical sensing inputs for skewed approaches or slight curves.

f. The unit shall have a built-in terminal strip to simplify wiring connections.

g. The unit shall receive power from the phase selector and be operational from 16 to 40 unregulated DC volts.

h. The unit shall be responsive to the optical emitter at a distance of 1,800 feet (549m).

i. The unit shall be capable of providing the necessary electrical signal to the phase selector through up to 1,000 feet (305m) of optical detector cable.

j. The unit shall employ a replaceable circuit board assembly and photocells to facilitate repair.

3. Optical Detector Cable

a. Optical system cable shall be tested and certified by the manufacturer of the priority system components that the cable meets or exceeds matched component system performance.

b. The cable must guarantee delivery of the necessary quality signal from the optical detector to the phase selector over a non-specified distance of 1,000 feet (305m).

c. The cable must guarantee sufficient power to the optical detector over a non-specified distance of 1,000 feet.

d. The cable must be of durable construction to satisfy the following installation methods:

- Direct burial
- conduit and mast arm pull
- Exposed overhead (supported by messenger wire)

e. The weight must not exceed .04 lbs./ft. (65.5 grams/meter).

f. The outside diameter shall not exceed 0.3 inches (7.62 mm).

g. The insulation rating must be 600 volts minimum.

h. The temperature rating must be 80° C minimum.

i. The cable shall have 3 conductors of AWG20 (7 x 28) stranded, individually tinned, copper color coded as follows:

- Orange for delivery of optical detector power (+)
- Blue for optical detector power return (-)
- Yellow for optical detector signal

j. The conductors will be shielded with aluminized polyester and have an AWG20 (7 x 28) stranded and individually tinned drain wire to provide signal integrity and transient protection.

k. The shield wrapping shall have a 20% overlap to ensure shield integrity following conduit and mast arm pulls.

4. Phase Selection Equipment

a. The priority control system manufacturer shall offer devices to assure interface electro mechanical controllers, solid-state controllers with or without internal priority control capability, and Type 170 controllers with internal priority control software.

b. Phase selector for use with Type 170 traffic controllers:

1) Shall be a plug-in, two channel, dual priority device intended to be installed directly into the input file of Type 170 controllers equipped with priority phase selection software.

2) Shall be powered from AC mains and contain an internal, regulated power supply to power optical detectors.

3) Shall be capable of recognizing the following pulse rates as delivered by the optical detectors:

   - 9.639+/-.119Hz as Frequency I
   - 14.035+/-.255Hz as Frequency II

4) Primary optical detector inputs and power outputs shall be on the card edge. Two additional detector inputs, per channel, shall be provided via a front panel connector.

5) An opto-isolated output shall provide the following signals to the card edge:

   - 6.25+/-.02Hz pulse in response to a low frequency signal
   - A "Steady-On" in response to a high frequency signal

6) Shall utilize crystal controlled timing and optical pulse rate recognition circuitry to assure:

   - Accurate optical signal recognition (dual frequencies)
   - Synchronous logic
   - Precise output pulse
   - Accurate call drop-out time

7) Shall have six recessed range control per channel, three per frequency, to independently adjust optical sensitivity.

8) Shall have a solid-state "Power-On" indicator.

9) Shall have a "Frequency I" and "Frequency II" solid-state indicator for each channel which performs as follows:

- Flashing during call validation
- Be steady-on when processing a valid call and during test switch operation

10) Shall have a test switch for each channel to deliver Frequency I or Frequency II signal pulse rate to verify proper function at both optical emitter flash rates, first-come, first-served operation, and Frequency II override capability.

11) Shall have a selectable call dropout time of 5 seconds (10 seconds optional) -0 to +2.5%.

12) Shall properly identify a Frequency II demand with any combination of up to 10 high and low priority emitter signals being received simultaneously and asynchronously on either channel.

13) Shall not exceed the following dimensions:

- Length (including handle) 7.91 inches (200.7mm)
- Width 1.11 inches (29.18mm
- Height 4.50 inches (114.3mm)

E. Reliability

1. All equipment supplied as part of the optical priority remote traffic control system intended for use in the controller cabinet shall meet the electrical and environmental specifications spelled out in the NEMA Standards Publication TSI - 1983, Part 2:

   a. Line voltage variations per NEMA TS1 - 2.1.2

   b. Power source frequency per NEMA TS1 -2.1.3

   c. Primary power interruptions per NEMA TS1 - 2.1.04.A.1

   d. Power source noise transients per NEMA TS1 - 2.1.6.1

   e. Power source high energy transients per NEMA TS1 - 2.1.6.2

   f. Non-destruct transient immunity per NEMA TS1 - 2.1.8

   g. Input-Output immunity per NEMA TS1 - 2.1.7

   h. Temperature range per NEMA TS1 - 2.1.5.1

   i. Humidity per NEMA TS1 - 2.1.5.2

   j. Shock test per NEMA TS1 - 2.1.13

   k. Vibration per NEMA TS1 - 2.1.12

2. All equipment supplied as part of the priority control system intended for use in or on emergency vehicles shall operate properly under any combination of the following environmental Conditions.

   a. Temperature range: -30° F (-34° C) to + 140° F (+60° C)

   b. Relative Humidity: 0 to 95%

   c. Vehicle battery voltage: 10 to 15 volts

F. Manufacturer's Responsibilities

1. The manufacturer and/or the manufacturer's representative shall provide quality service before, during, and after installation of the priority control system. The manufacturer and/or the manufacturer's representative as consultants to the installer must provide certified trained technicians having traffic systems industry experience and operational knowledge of priority control systems.

2. Prior to bid/quote activity, the manufacturer or its authorized representative shall be required to conduct field surveys of intersection control equipment or review design

documentation to determine the most appropriate phase selection device for each location and to recommend locations for installing optical detectors.

3. After an award, the manufacturer or its authorized representative shall be responsible for system documentation including the following:

   a. Acquire all relevant controller information.

   b. Determine the number of vehicle phases (greens).

   c. Determine the desired greens for priority approaches.

   d. Determine ring configuration of each controller.

   e. Establish pedestrian phase timing requirements.

   f. Establish minimum green times for non-priority phases.

   g. Establish the manipulation method of each controller type.

   h. Supply interface information to installer.

   i. Assist in system checkout prior to purchaser's acceptance by:

      - Verifying proper installation per recommended interfaces
      - Verifying that optical ranges are properly set
      - Verifying that phase selector timings or controller software timings are properly set

      System checkout requirements when using the plug-in version of phase selector must include verification that when two plug-in units are used, the controller must recognize high frequency over low frequency and first-come, first served. All possible conditions of priority control must be considered. This may require software and/or hardware changes in the traffic controller. Software and programming of these controllers is the responsibility of the purchasing/using agency.

   j. Instruct emergency vehicle operators or their representatives in the operation of the system. Instruction shall include introductory training, periodic training updates, and a leave-behind audio visual self-instruction course for on-going training.

   k. Instruct maintenance personnel in routine maintenance of the system.

G. Warranty and Certificate of Insurance

1. Manufacturer shall warrant that, provided the priority control system has been properly installed, operated and maintained, component parts of a matched component system that prove to be defective in workmanship and/or material during the first ten (10) years from date of shipment from manufacturer, shall be covered in a documented system protection plan.

   Guaranteed warranty substantiates the manufacturer's financial ability to process warranty claims. This guarantee shall be determined in reference to the

manufacturer's business assets and financial experience over the preceding five (5) business years.

2. In addition, upon request, the manufacturer shall provide documentation proving ability to financially support the ten (10) year provisions of the warranty. Documentation shall include appropriate financial reports for the previous five (5) business years.

3. The protection plan shall warrant that component parts, of a matched component system, that prove to be defective in workmanship and/or material during the first five (5) years from date of shipment from manufacturer will be repaired at no charge and that extended coverage with a fixed repair deductible will be available for an additional five (5) years.

4. In total, the warranty coverage must assure ten year operational reliability and interface compatibility with future components designed for the system.

5. A copy of the manufacturer's warranty outlining the conditions stated above shall be supplied with bid.

6. Certificate of Insurance
   The manufacturer shall provide a certificate of insurance protection for $5,000,000. This certificate assures the priority control user that the manufacturer is insured against civil damages if proven to be at fault for an accident due to equipment failure within the system of matched priority control components. This certificate, however, need not, and is not meant to, provide liability insurance protection to the priority control system user.

7. The manufacturer of the priority control system shall certify that all component products are designed, manufactured, and tested as a system of matched components and will meet or exceed the requirements of this specification.

APPENDIX A
Scottsdale Transportation Systems Department, Operations Division (STSDOD)
November 1999

QUALIFIED PRODUCTS LIST:

Type 170 System Cabinet:
Model 330 Cabinet
Safetran Traffic Systems, Inc.
McCain Traffic Supply

Model 412 Program Module:
Safetran Model 412B
Dynatrol Model 412B
Safetran Model 412B2

Type 170 Controller Units:

Safetran Traffic systems, Inc.	170SV
Dynatrol	170E
Topping	170E
McCain	170E

Telemetry Units:
General Devices, Inc. (G.D.I.), Model 400 modem, Rev. E

Type 170 Controller Unit Software:

Wapiti Micro Systems Corp.	W4IKS, current Rev.
Wapiti Micro Systems Corp.	Traffic View, current Rev.

Model 200 Load Switch – Category 1:
PDC – SSS-87
Solid State Device 200K

Model 200 Load Switch – Category 2:
PDC – SSS-88
Solid State Device 200D

Model 204 Flashers – Category 1:
PDC – SSF-87
Solid State Devices 204K

Model 204 Flashers – Category 2:
PDC – SSF-88-X
Solid State Devices 204D

Model 210 Conflict Monitor:
Solid State Devices Model 210P
Solid State Devices Model 210PC
Eberle Design, Inc., Model 210E

APPENDIX A (Continued)
Scottsdale Transportation Systems Department, Operations Division (STSDOD)
November 1999

Model 222 Detectors – Category 1:
3M Canoga Model P422T
Detector Systems Model 222D
3M Canoga Model C422 or C424

Model 222 Detectors – Category 2:
Detector Systems Model 222B
Indicator Control Corp., Part #3DLD827B
3M Canoga Model C422 or C424

Model 242 Two Channel DC Isolators:
General Devices & Instruments Model 242
PDC Model 242
Detector Systems

Model 252 Two-Channel AC Isolators:
PDC Model ACI-88
Detector Systems

Model 430 Relays:
Magnecraft Model W21 ACPX-2
Midtex 136-62T3A1
Traconex Model W21 ACPX-2

Model 721 Optical Detector:
Indicator Controls Corporation
3-M Safety and Security System Division

Model 752 Phase Selector:
Indicator Controls Corporation
3-M Safety and Security System Division

Model 196 High Priority Emitter Assembly:
Model 292 H Indicator Controls Corporation
3-M Safety and Security System Division

Model 195 Low Priority Emitter Assembly:
Model 292 L Indicator controls Corp.
3-M Safety and Security System Division

Model 138 Optical Detector Cable:
Indicator Controls Corporation
3M Safety and Security System Division

LED Signal Indications
Dialight model 430-1315-001 or approved equivalent with temperature compensation and power correction

APPENDIX A (Continued)
Scottsdale Transportation Systems Department, Operations Division (STSDOD)
November 1999

The effective period this QPL is indeterminate. Manufacturers are required to notify the 170 Program Coordinator of any proposed changes affecting design or performance in the product that has been approved. This includes all components listed in manuals and all engineering changes.

Manufacturers not on the list who want their assemblies or units tested so as to be added to the QPL for future bids should submit a written request to the 170 Program Coordinator*.

Failure to perform satisfactorily on purchase orders by failing to meet delivery schedules or maintain a high rate of acceptance will result in being removed from the QPL.

*170 Program Coordinator:
Dan Edwards
(602) 391-5673 (5637)
email: dedwards@ci.scottsdale.az.us

City of Scottsdale
Municipal Services Department
9191 E. San Salvador
Scottsdale, AZ 85258

Traffic Signal Structures:

ADOT/Scottsdale	
Valmont Industries, Inc.	Drawing #DB00181, no Rev.
Valmont Industries, Inc.	Drawing #DB00182, no Rev.

Couplet “Trombone” Type Pole

Valmount Industries, Inc.	Drawing #DB00243,
(Or Ameron Pipe - #505, Revision B – verify)	

APPENDIX B
CAL-TRANS
April 1996

QUALIFIED PRODUCTS LIST:

Controller Assemblies for the Model 170 Traffic controller

The assemblies listed below have been tested by the California Transportation Laboratory and found to be compliant to the "Traffic signal Control Equipment Specifications" (TSCES), dated April 1978, and applicable addendum.

When these assemblies are to be purchased, only those listed below will be considered.

QUALIFIER TO QUALIFIED PRODUCTS LIST (QPL):

A manufacturer's listing on the QPL does not waive any of the requirements of the specifications or relieve the manufacturer/contractor of any obligation thereunder. Defective work, materials, and equipment will be rejected.

In short, all equipment submitted must comply to current specifications.

MODEL 232 DUAL MAGNETIC DETECTOR SENSOR UNIT
- Safetran

MODEL 242 TWO-CHANNEL DC ISOLATORS
- Detector Systems
- General Devices, Inc. (GDI) – DIM 242
- PDC – DCI-82
- Traffic Sensor (TSC)

MODEL 252 TWO-CHANNEL AC ISOLATORS
- General Devices, Inc. (GDI) – 252CA
- PDC – ACI-88
- Traffic Sensor (TSC)

Model 332A CABINETS
- McCain Traffic Supply
- Peek Traffic/Signal Control Company
- Safetran Traffic Systems, Inc.
- Traffic Sensor (TSC)

MODEL 334C CABINETS
- McCain Traffic Supply
- Peek Traffic/Signal Control Company
- Safetran Traffic Systems, Inc.
- Intersection Development Corporation

MODEL 400 MODEMS
- General Devices, Inc. (GDI), Rev. E
- General Devices, Inc. (GDI), Rev. F
- PDC
- Sonex

APPENDIX B (Continued)
CAL-TRANS
April 1996

MODEL 412 PROGRAM MODULE
- Automatic/Eagle Signal – 412C
- Dynamic Traffic Systems (Dynatrol) – 412C
- McCain Traffic supply – 412C
- Peek Traffic/Signal Control Company – 412C
- Safetran Traffic Systems, Inc. – 412C
- Topping Electronics, Inc. – 412C

PDA2 (POWER DISTRIBUTION ASSEMBLY)
- McCain Traffic Supply
- Peek Traffic/Signal Control Company
- Safetran Traffic Systems, Inc.
- Traffic Sensor (TSC)
- Intersection Development Corporation

PDA3 (POWER DISTRIBUTION ASSEMBLY)
- McCain Traffic Supply
- Peek Traffic/Signal Control Company
- Safetran Traffic Systems, Inc.

The effective period of this QPL is indeterminate. Manufacturers are required to notify the 170 Program Coordinator of any proposed changes affecting design or performance in the product that has been approved. THIS INCLUDES ALL COMPONENTS LISTED IN MANUALS AND ALL ENGINEERING CHANGES.

Manufacturers, not on the list, who want their assemblies or units tested so as to be added to the QPL for future bids should submit a written request to the 170 Program Coordinator.

Failure to perform satisfactorily on purchase orders by failing to meet delivery schedules or maintain a high rate of acceptance will result in removal from the QPL.

ROBERT MCMILLAN
170 Controller Program Coordinator
(916) 654-4385
Calnet 646-4385
FAX: (916) 653-3053
Calnet FAX: 800-453-3053

DEPARTMENT OF TRANSPORTATION
Division of Traffic Operations
1120 N. Street
Sacramento, CA 95814

Section 3.3

Transit

Design Standards and Policies Manual
Revised December 1999

Chapter 3
Transportation

SECTION 3.3
TRANSIT

PAGE INDEX

SECTION 3.3
TRANSIT

3-301 INTRODUCTION

A. PURPOSE

This section documents transit facility guidelines for Scottsdale's public works projects and for developers working on projects that will impact the transit system. This includes projects that create high-activity centers such as shopping malls or high-density living areas.

Criteria are documented for locating bus stops and transit amenities such as bus benches and transit shelters. It includes street geometrics for bus bays, standard signage and review and submittal requirements. There is also a brief discussion on landscaping as it relates to transit amenities.

The guidelines consider the needs of the transit user, the bus operator, neighbors adjacent to bus stops and the general public.

B. APPLICABILITY

The information presented in this document is intended for use by engineers, developers, and City staff.

These guidelines are generalizations applicable to most situations. They are not intended as detailed engineering solutions; each site will have its own unique set of needs. Rather, transit-related design solutions may need to be adjusted to fit specific sites and applicable codes.

Developers are responsible for obtaining all city approval and permits necessary to complete the transit improvements.

C. GOALS

The goal of these guidelines is to provide a clean, safe, comfortable and convenient environment for users of Scottsdale's transit system, and to provide developers a framework in which transit amenities are stipulated for new projects.

All transit improvements will be designed to meet the regulations set forth by the Americans with Disabilities Act (ADA).

3-302 CRITERIA FOR BUS STOP LOCATIONS

A. BUS STOP SPECIFICATIONS (See Section 3-304 for Bus Bay Descriptions.)
Frequency of bus stops is dictated by the degree to which bus patrons are willing to walk to board a bus. The minimum standard for bus stop locations in Scottsdale is at quarter mile intervals for residential areas and one-eighth mile intervals for major activity centers.

In order to provide the greatest convenience and safety for passengers, bus stops are generally located as close to intersections as possible. This minimizes walking distance for transferring passengers and encourages the use of crosswalks. Far side stops, those located immediately past an intersection, are optimal for the following reasons:

- Minimal interference with traffic flow
- Minimal interference with intersection sight distance
- Less likelihood of passengers crossing in front of a bus
- Less conflict for automobile right turns
- Less obstruction for vehicles entering the intersection from a side street
- More effective re-entry for bus into the traffic stream

Near-side bus stops (those stops located immediately before an intersection) are considered when placement of far-side stops is not feasible or when that stop will be located near buildings with high volumes of transit riders. These types of stops may also be located where a high-volume bus transfer location would otherwise require a pedestrian crossing at a busy street.

On occasion a mid-block bus stop may be utilized to provide access to a major generator, but it is generally discouraged due to the likelihood that pedestrians would cross streets mid-block rather than at an intersection.

The location of a transit stop is generally 85 feet, plus or minus 25 feet from the curb of an unsignalized intersection and 120 feet plus or minus 25 feet from a signalized intersection. The paved loading area should be clear of any obstructions. (Figure 3.3-1 - 3.3-3)

Where a development or subdivision is walled-off from the street, steps should be taken to allow easy pedestrian access. This could include a pedestrian access path linking various sections of the development to the bus stop or a system of offset walls around developments, which allow pedestrian passage.

All transit stop furniture must be placed outside the standard five-foot sidewalk. A minimum three foot clearance is required between transit components and fire hydrants, switch boxes, mail boxes, etc.

B. ACCESSIBILITY
All transit facilities must comply with the applicable provisions of the Americans with Disabilities Act. In general, a 36” clearance is to be maintained between bus stop components to allow for maneuvering by wheelchairs. A minimum clear length of 96 inches (measured from the curb or roadway edge) and a minimum clear width of 60 inches (measured parallel to the roadway) shall be provided at all transit locations where a sidewalk is available. (Figures 3.3-4)

(See Figures 3.3-5 thru 3.3-8, MAG Standard Details 230 & 231, and City of Scottsdale Standard Details 2232 for related issues.)

3-303 TRANSIT AMENITIES

Comfortable and secure passenger waiting areas should be provided at as many bus stops as feasible. The waiting areas may include a varying range of improvements depending upon ridership and specific site needs. Below are typical transit amenities and conditions under which they should be employed.

Advertising and placards are not allowed by city ordinance.

A. BENCHES

Benches should be located at all bus stops.

Several styles of benches have been approved for placement in Scottsdale. Specialty benches are used in downtown Scottsdale. (See City of Scottsdale Standard Detail 2268 for slab requirements.) A plastic-coated blue bench with matching trash receptacle is used in all other areas except for those bus stops affected by the Environmentally Sensitive Land Ordinance (ESLO). Transit amenities located within ESLO boundaries (Figure 3.3-9) must conform to its guidelines. Additional styles may be acceptable and need city staff approval.

B. SHELTERS

Shelters should be located at all bus stops. In a development, any requirement for bus shelters may be waived if adequate exterior shading and architectural shelter is provided by the developer.

Shelters should be arranged with considerations to the sun's angles. Coverage should allow for maximum shade during the peak use hours of the summer morning and afternoon. The shelter should be oriented, however, to allow the bus driver clear visibility of the passenger and to allow passengers a view of oncoming traffic.

Scottsdale has a standard shelter design; developers and other interested parties should contact the Transportation Planning Division of the City of Scottsdale Transportation Department for copies of these plans. (See also Figure 3.3-10 for general layout and City of Scottsdale Standard Detail 2268-2269 for related issues.) Other shelter designs may be used provided it is approved by the City and the Development Review Board. Shelter designs must meet the following criteria:

- Minimum canopy of 65 square feet with a minimum width of 5.5 feet
- Minimum 7 feet clearance between underside of roof and sidewalk surface
- Shelter canopy will be waterproof with provisions for drainage away from transit users
- Seating areas will be shaded
- Provide security for transit passengers
- Have a minimum 6 inches vertical clearance from the sidewalk to avoid collection of trash and debris
- Fixed components to prevent unauthorized removal
- Materials will allow for air circulation and avoid containment of hot air
- Materials must be finished to prevent overheating
- Canopy materials that collect and radiate head will be insulated.
- Materials, coatings and surfaces will be graffiti resistant
- Components of the shelter will be readily replaceable
- Colors respond to the architectural character of the development and the transit system (Per review and approval of Development Review Board)
- Minimum two foot clearance between roof canopy and face of curb

C. OTHER
- Trash receptacle with a minimum capacity of 30 gallons
- Minimum of 6 linear feet of seating located under the shelter canopy
- Transit information holder will be placed in a well-lit portion of the shelter
- Bus stop graphics per City requirements
- Minimum two bike loops (Refer to Section 3.4 Bikeways and City of Scottsdale Standard Detail 2285)

3-304 BUS BAYS (PULLOUTS)

Bus bays enable buses to pull completely out of the traffic lane while loading and unloading passengers. Bus bays are recommended under the following conditions:

- At or near transfer points
- Along arterial streets
- At locations recommended by the City's Traffic Engineering staff
- At layovers at the end or along bus routes
- When average peak period boardings exceed 5 people per bus or
- When average peak period dwell time exceeds 30 seconds per bus or
- When there have been 5 accidents involving buses within the past year
- At locations where wheelchair boardings are likely

Two types of bus bays are allowed: open-ended and closed. Generally, open-ended bays are used on far-side stops where space is limited. Closed bus bays are the preferred option. (See Figure 3.3-11 for generalized dimensions and City of Scottsdale Standard Details 2266-1, 2266-2, and 2267 for specific dimensions.)

3-305 PARK AND RIDE LOTS

Park-and-ride lots provide free automobile parking and allow patrons convenient access to public transit. These facilities may be combined with transit centers or major transfer centers. They are also found at shopping malls and near large employment centers.

The purpose of park-and-ride lots is to intercept automobile trips close to their origin and to transfer patrons to buses for the remaining portion of the trip.

Park-and-ride lots should be located in conformance with the Circulation Element of Scottsdale's General Plan. Additionally, these lots should be located at express bus route stops at major activity centers.

3-306 MAJOR TRANSIT CENTERS

Two types of major transit centers are described below.

The first type is a Transfer Center where several bus routes converge. These facilities provide a convenient location for bus passengers to transfer between routes. They also typically provide direct pedestrian access to major activity centers.

Transfer centers include permanent facilities with a high level of transit amenities such as shelters, bike lockers, drinking fountains and information kiosks. They may be constructed off-street to include a bus turn-around loop, or on-street where major transfer activity occurs between intersecting or converging bus routes.

Criteria for locating major transfer centers are:

- Where regional and local bus routes intersect or
- At transfer points between two or more regional bus routes
- Near crossings of major arterial streets
- Adjacent to or in major activity centers

Transfer centers may also be combined with Park and Ride lots. The size of transfer center will vary depending on the anticipated needs, but are typically a minimum of 1.5 acres and accommodate at least 45 parking spaces if combined with a Park and Ride lot.

Another type of transit center is a telecommute center. Telecommute centers provide office space for commuters who can and wish to work closer to their homes. Typically office, meeting, and kitchen space is provided in addition to showers, parking, bike lockers, etc. Telecommute centers may be combined with other types of transit centers.

The Scottsdale Transit Plan has proposed several locations for both transit centers and park-and-ride lots (Figure 3.3-12).

3-307 LANDSCAPING

Landscaping may replace (with City staff approval) a requirement for a passenger waiting shelter. Shade trees and other protective landscaping should be provided wherever possible. This landscaping could be considered part of the development's frontage landscape and could count towards any landscaping requirements, which may apply. Considerations for selection and location of landscaping include:

- Trees should be mature and have an adequate canopy to shade the seating area
- Low-water consumption trees and shrubs should be used
- Tree location should consider the solar orientation of the transit stop. Priority should be given to shading afternoon summer sun
- Transit landscaping should be compatible with other frontage landscaping

All landscaping shall be carefully located so as not to obstruct the visibility of either the transit user or the bus operator. The developer/property owner shall be responsible for the maintenance of landscaping at bus stops. City staff has available landscape shelter specifications that are not included in this document. Copies are available.

3-308 SIGNAGE

A. BUS STOP SIGNS

The placement of bus stop signs is an important passenger convenience, operations and marketing tool for transit systems. Bus stop signs are positioned to notify passengers that the bus will stop at that specific location. They serve as a reference for bus operators and as a point of identity for the transit system.

The bus stop sign is generally not a traffic sign (except as noted below) since it is not displayed to regulate or warn motorists.

A regional bus stop sign is currently in use throughout the Valley (Figure 3.3-13). The sign is 18" wide by 24" high, reflectorized for night time visibility and is double-faced so that it can be seen from both directions. The upstream side of the sign contains "No Parking" information for motorists approaching the bus stop.

The standard regional sign identifies a location as a bus stop and includes the name and number of the bus route(s) being served and the transit information telephone number.

B. SIGN PLACEMENT

Bus stop signs must be placed at the location where people board at the front door of the bus. In cases where the bus stop sign is incorporated into the design of a transit shelter, the need for a separate sign may be eliminated.

Ideally, bus stop signs should be placed independently of all other signs to maintain the importance of the bus stop identity. It should be installed with its own sign post although non-wood light poles may be used if it is at the proper stop location and if the sign face is visible from both sides. Signs are not to be placed on wood poles as it poses a hazard to linemen who climb the poles.

Bus stop signs should be installed on sign posts or metal poles so that the sign is "flagged". In other words, the sign should be attached to the post by its edge. This allows both sides of the sign to be viewed without obstruction. The bottom of the sign should be seven feet above ground level, at least two feet from the curb face and away from obstructions such as landscaping or other signs. The standard regional sign has been designed so that it may be mounted by its edge to a two-inch post without obscuring the backside message. Where metal street light poles are at the proper location but too close to the curb, the signs may be flagged away from the street. (Figure 3.3-14)

Usually, the City will be responsible for the installation of bus stop signs.

3-309 BUS STOP MAINTENANCE

Well-maintained bus stops are crucial to the image of the transit system. Damaged furniture and trash build-up should be tended immediately to create a positive impression for transit patrons and the general public.

Regular maintenance should include:

- Full wash down of shelter and accessories
- Removal of all dirt, graffiti, and pasted material
- Squeegee wipe down of glass surfaces
- Removal and replacement of trash bag
- Litter pick up around stop or shelter/accessories to a distance of ten feet
- Manual or chemical removal of weeds
- Pruning of obstructing tree growth
- Touch up of paint scratches

Repair of items that pose a safety problem should be performed within twenty-four hours. Repairs that do not pose safety problems should be completed within three days.

3-310 SUBMITTAL REQUIREMENTS AND REVIEW PROCEDURES

The following facilities must be delineated on all site plans or the preliminary plat submitted to the City:

- Major transfer centers
- Bus stops
- Park-and-ride lots
- Bus bays
- Shelters
- Bus benches

The design and location of the above mentioned facilities must be approved by Transit staff during the project review process.

Developers may deposit funds in lieu of construction and installation of stipulated transit amenities. The amounts of funds to be deposited are determined during the project review process and are in force upon City Council approval of the project. Fees are to be paid at the One-Stop Shop, 7447 East Indian School Road, in Bus Shelter Deposit Account #2151-24130-12151 when other permit fees are paid.

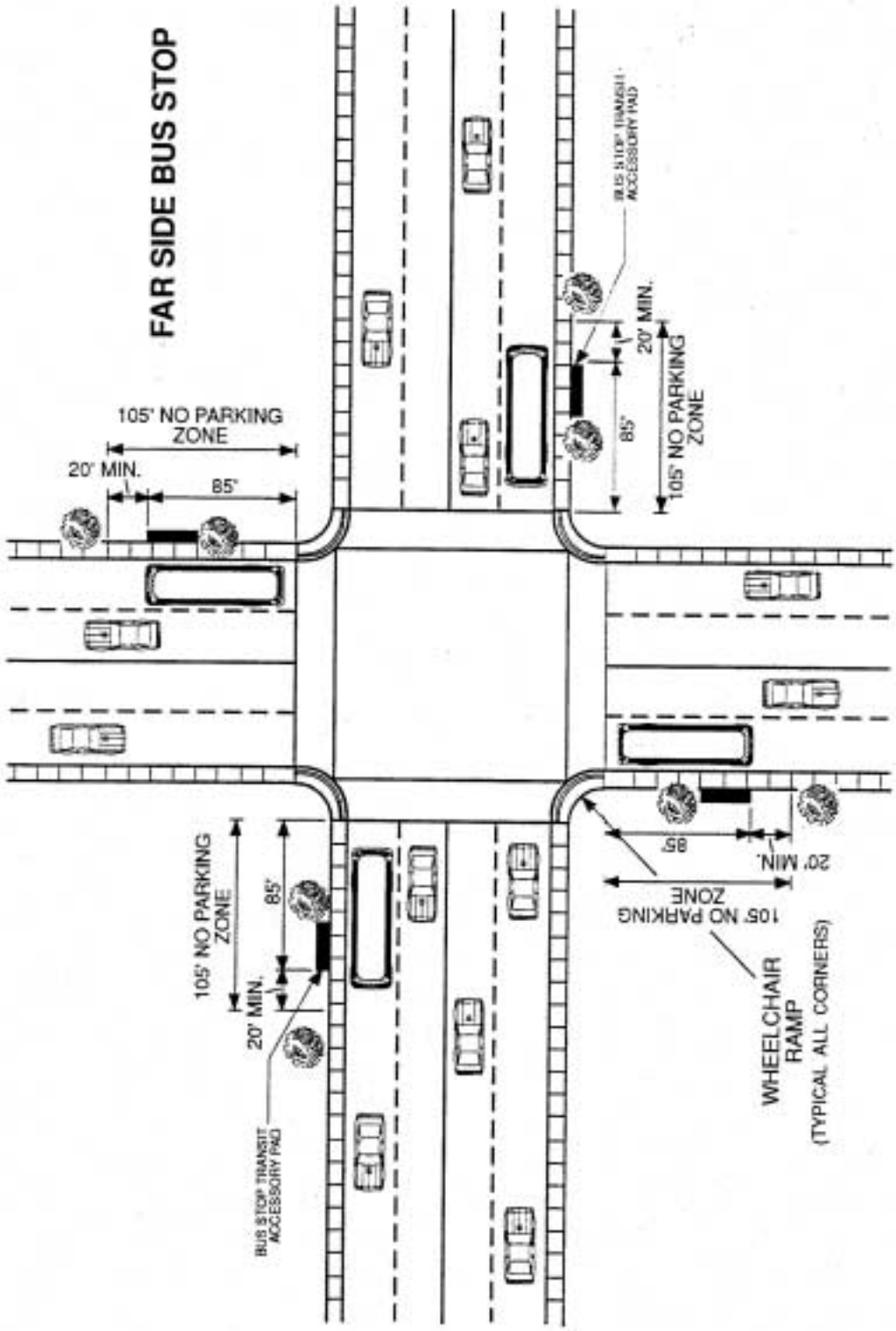


FIGURE 3.3-1

Standard Bus Stop Location

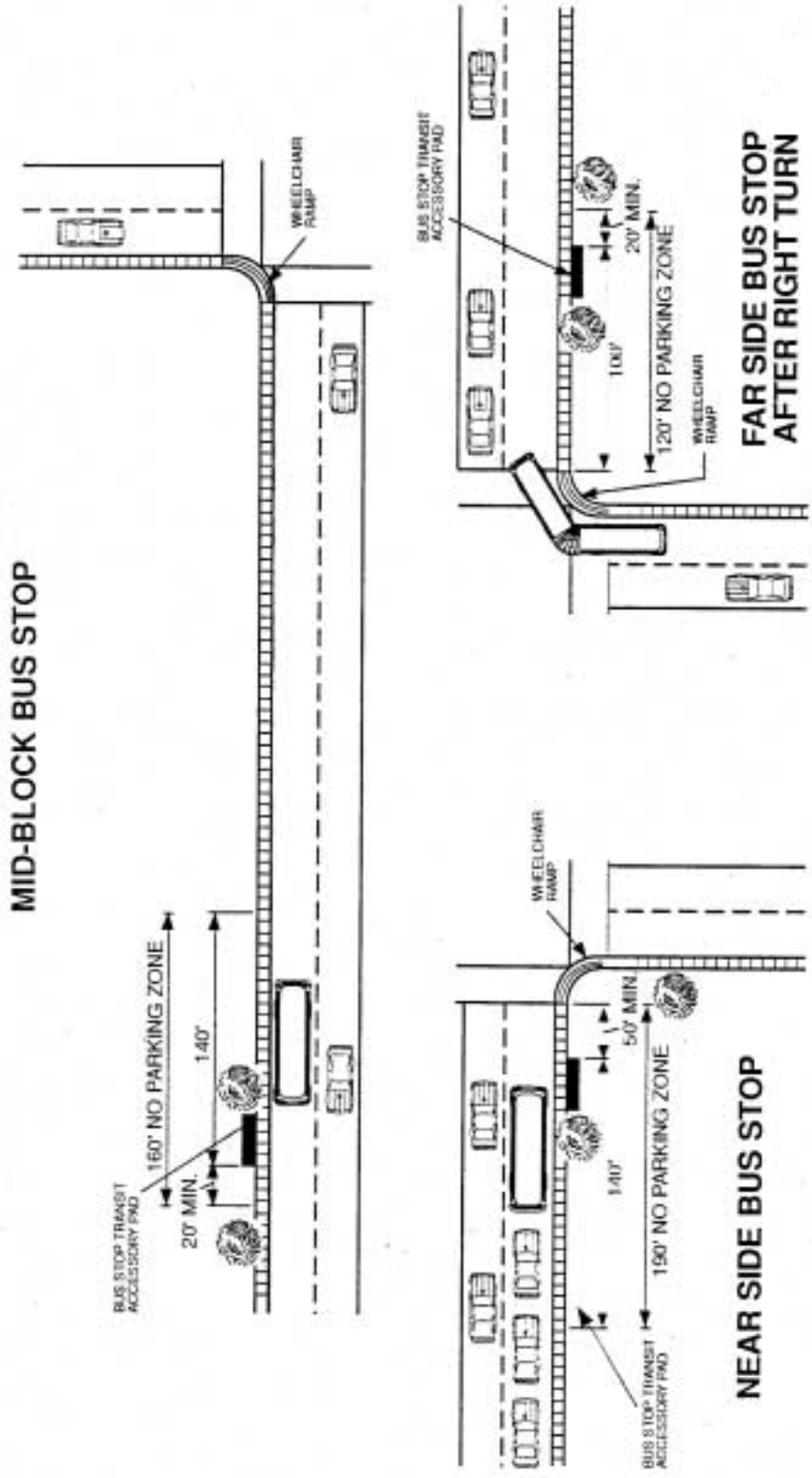


FIGURE 3.3-2

Special Condition Bus Stop Locations

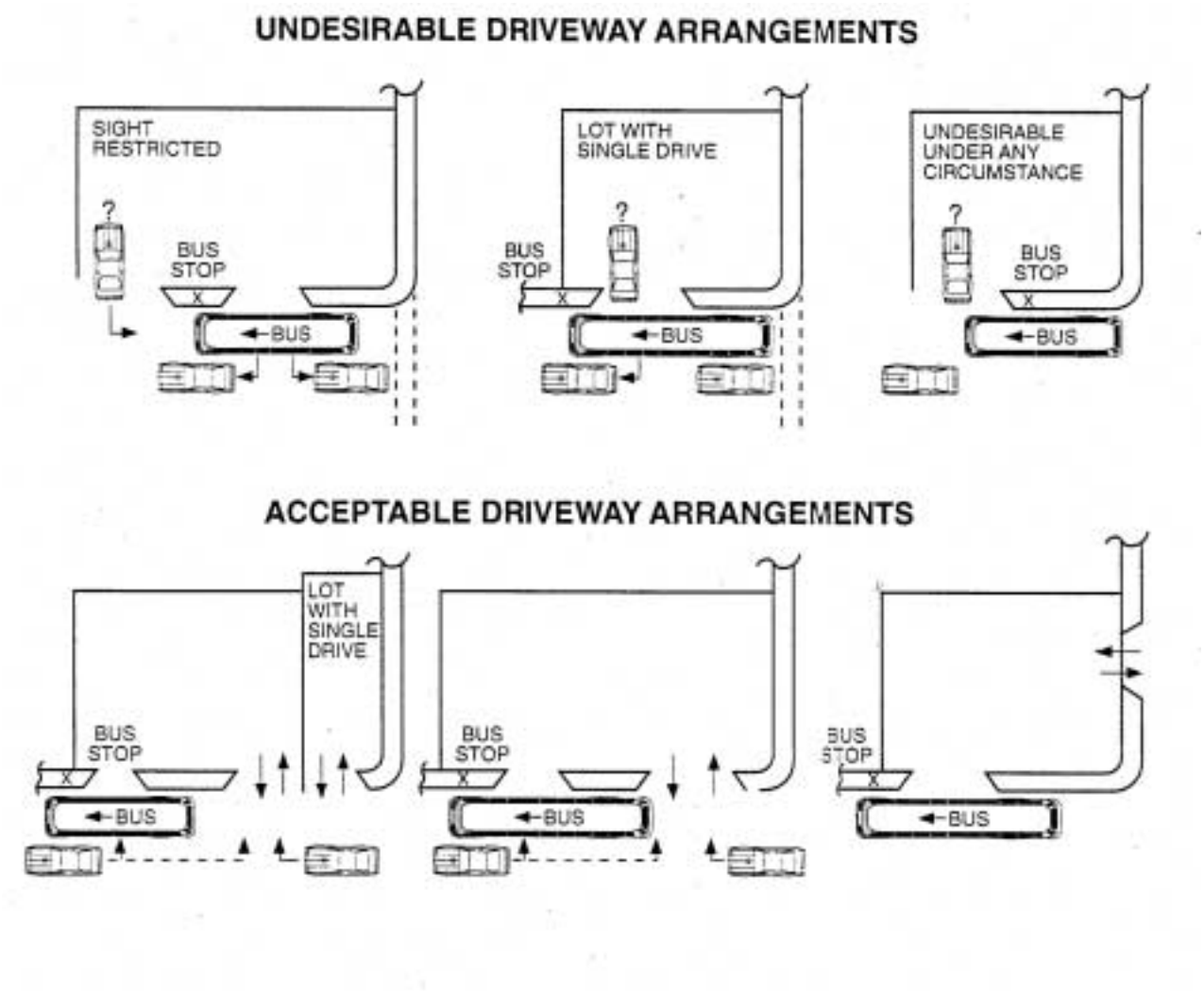


FIGURE 3.3-3

Driveway Locations near Bus Stop

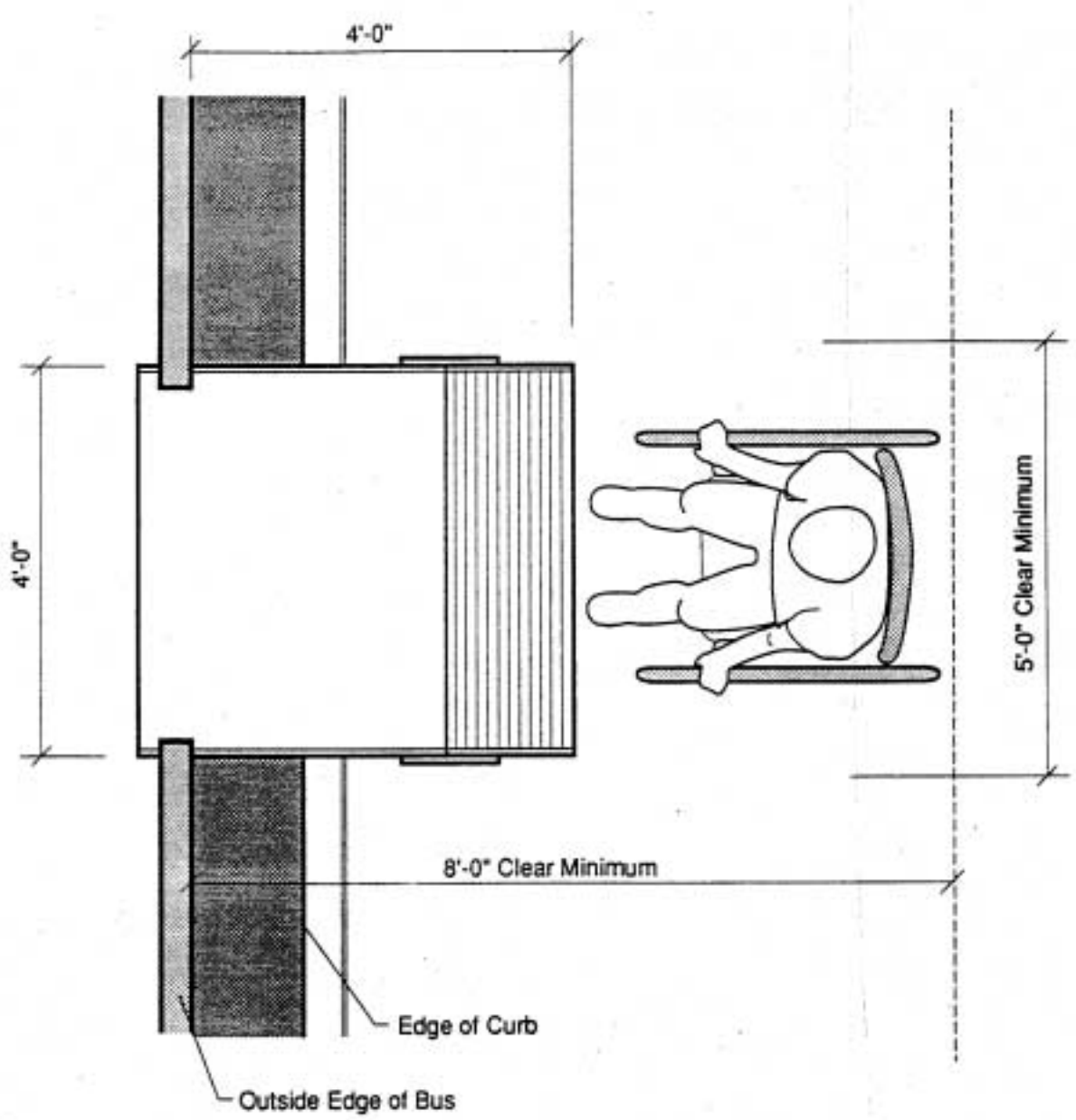


FIGURE 3.3-4

Wheelchair Lift Dimensions

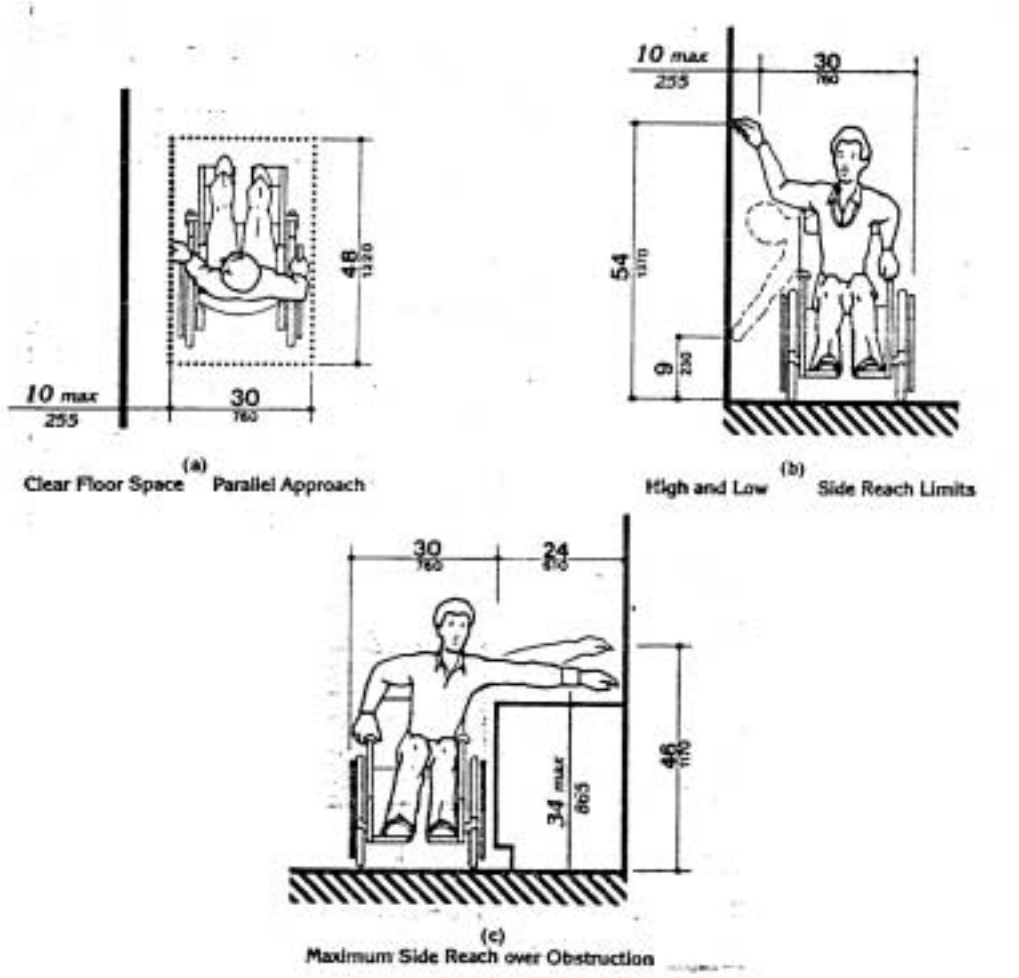


FIGURE 3.3-5

Wheelchair Accessible Routes Dimensions
(Page 1 of 2)

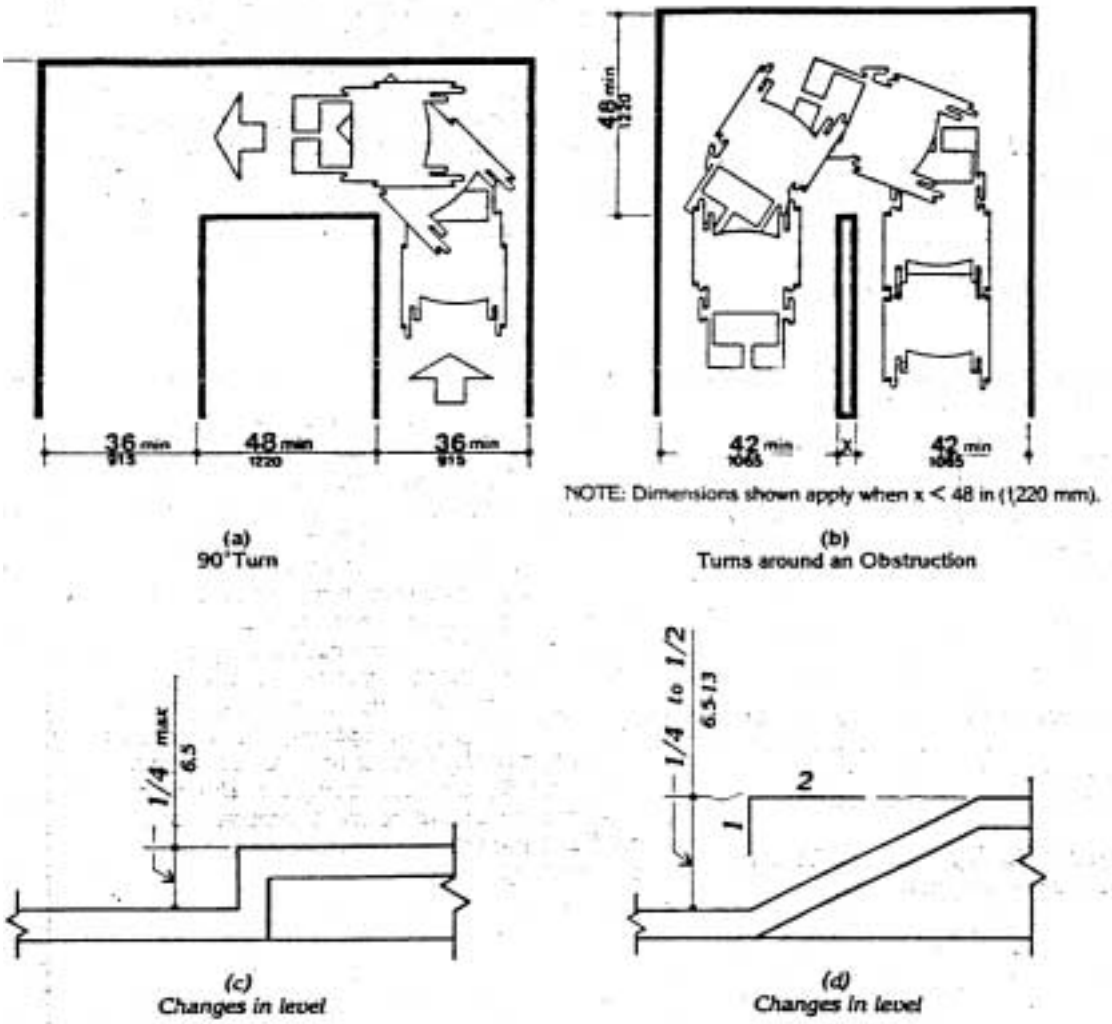
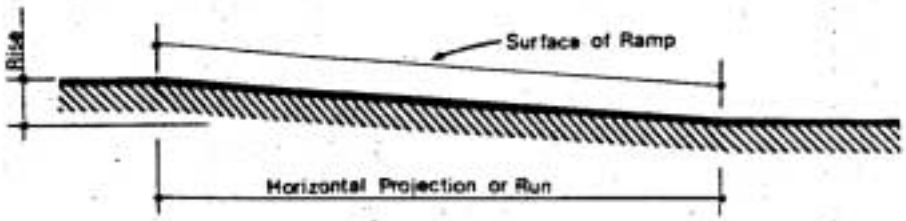


FIGURE 3.3-6

Wheelchair Accessible Routes Dimensions
(Page 2 of 2)



	Maximum Rise		Maximum Horizontal Projection	
Slope	in	mm	ft	m
1:12 to < 1:16	30	760	30	9
1:16 to < 1:20	30	760	40	12

FIGURE 3.3-7

Components of a Single Ramp Run and Sample Ramp Dimensions

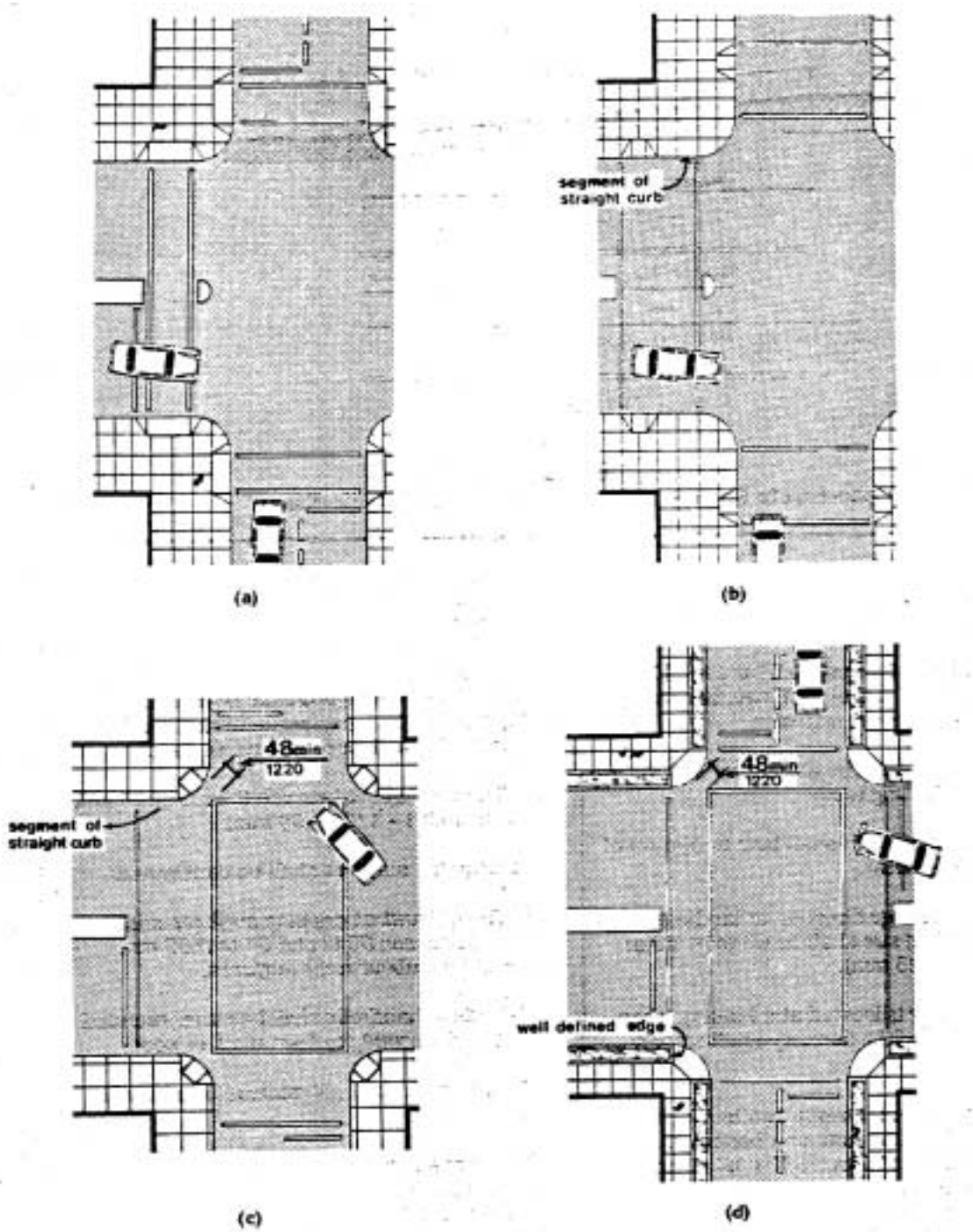


FIGURE 3.3-8

Curb Ramps at Marked Crossings

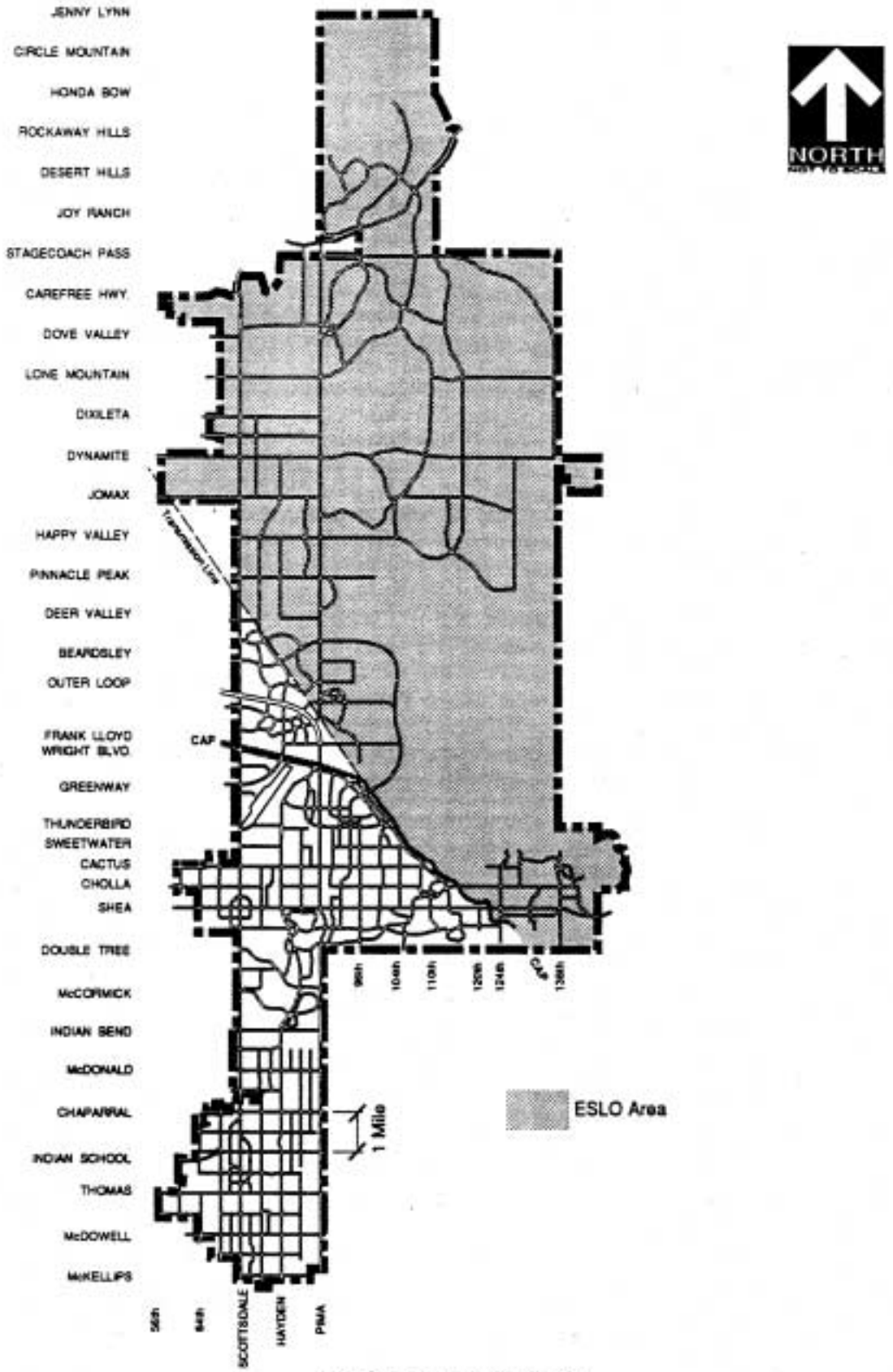
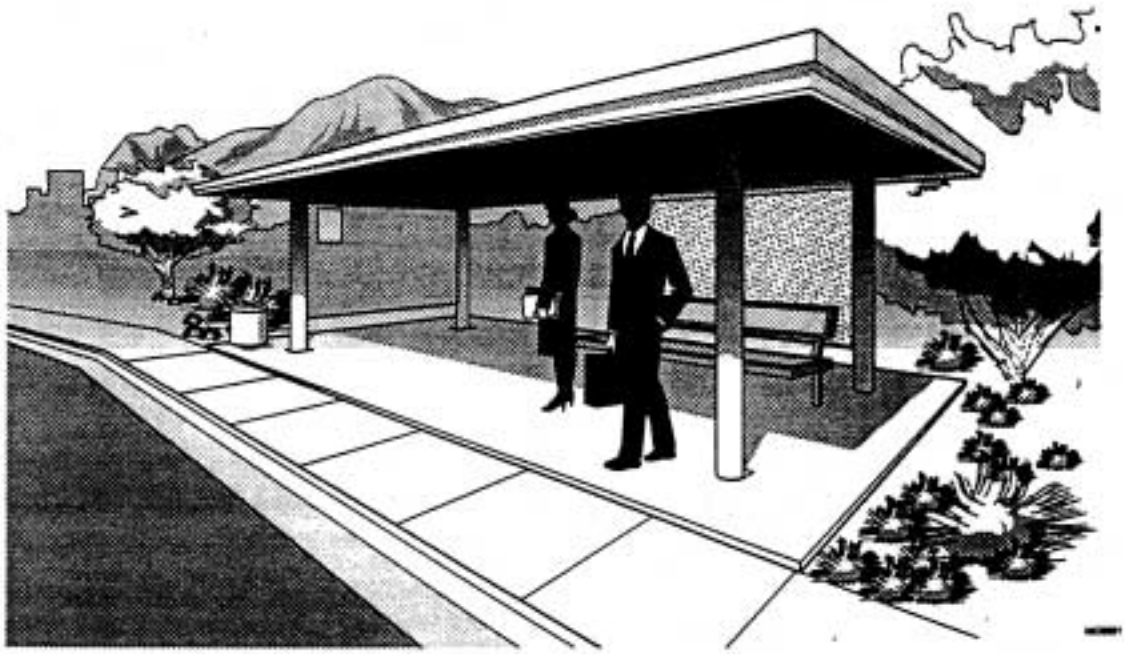


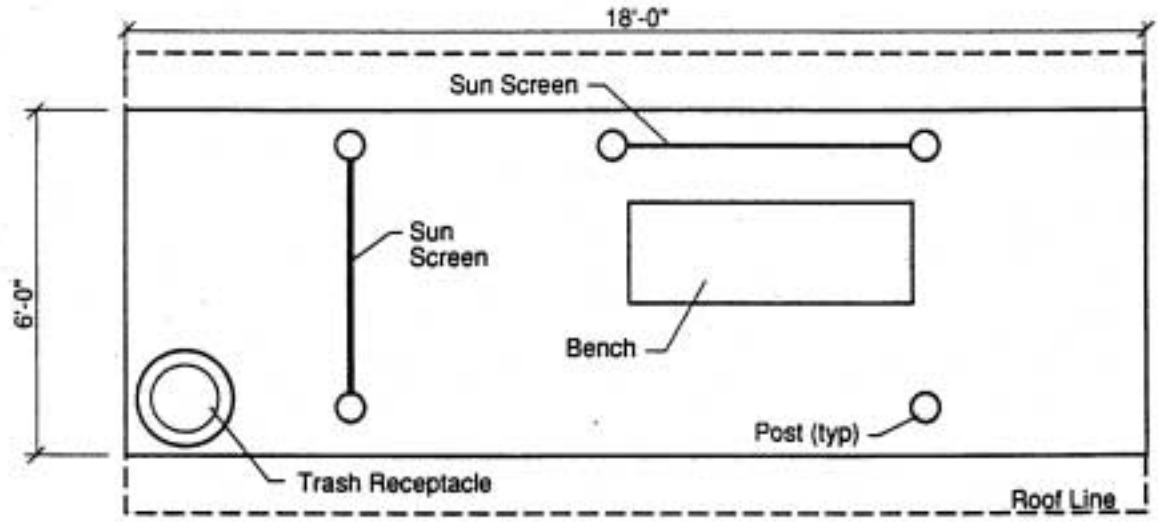
FIGURE 3.3-9

ESLO Boundary



Transit Shelter Perspective

Note: This figure in not intended as a construction document. Figures are not to scale.

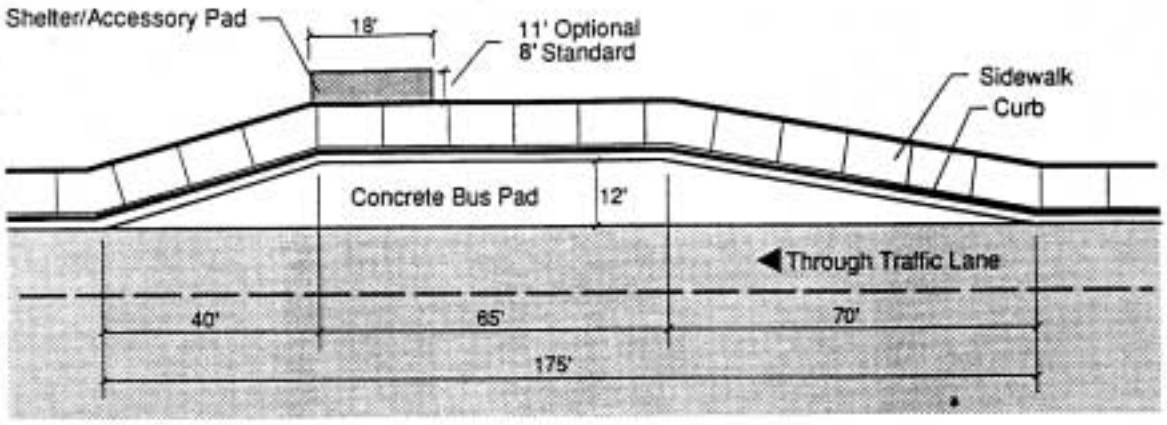


Transit Shelter Plan

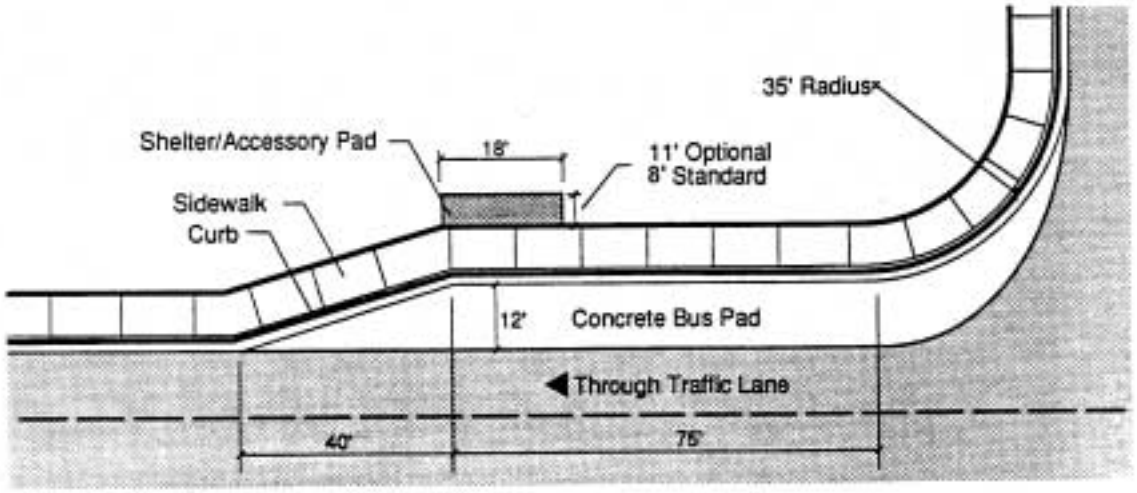
Note: This figure in not intended as a construction document. Figure is not to scale.

FIGURE 3.3-10

Standard Transit Shelter



Closed Bus Bay



Open-ended Bus Bay

Note: Driveways should be avoided within all bus bays. Under no circumstance should a driveway be placed within the shelter/accessory pad area.

FIGURE 3.3-11

Bus Bay Generalized Dimensions

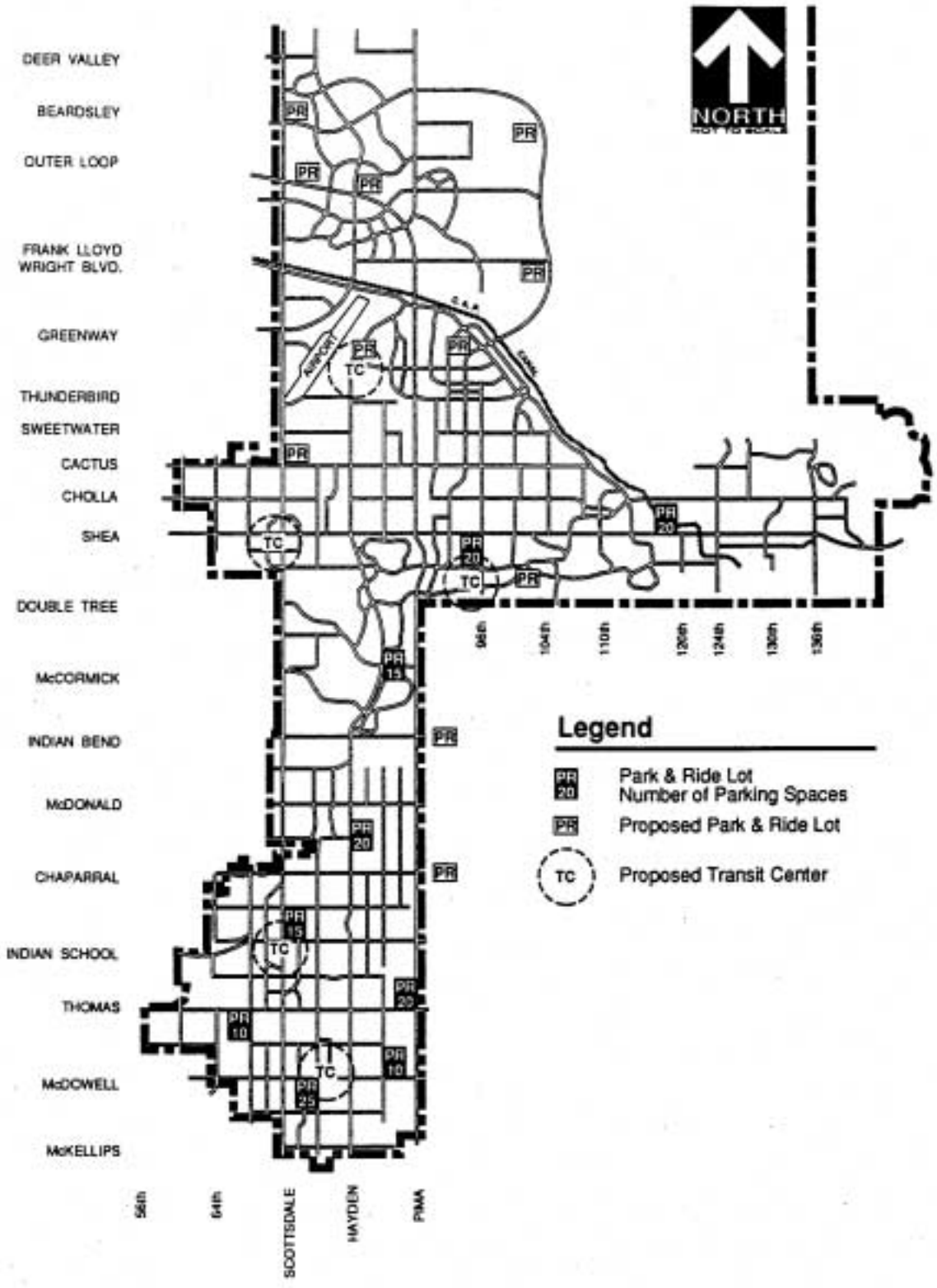


FIGURE 3.3-12

Park and Ride Lots and Transit Centers

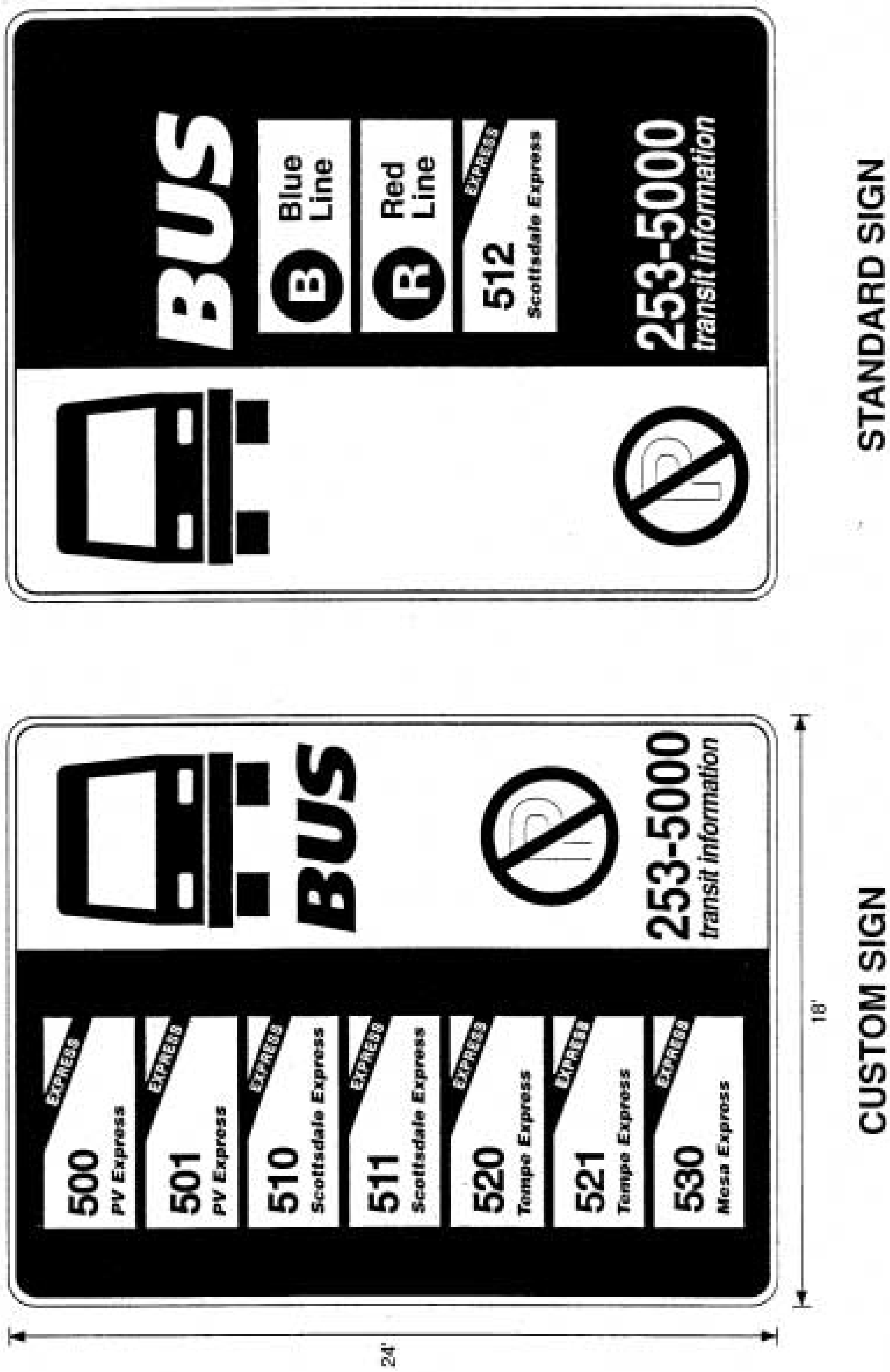


FIGURE 3.3-13

Bus Stop Sign

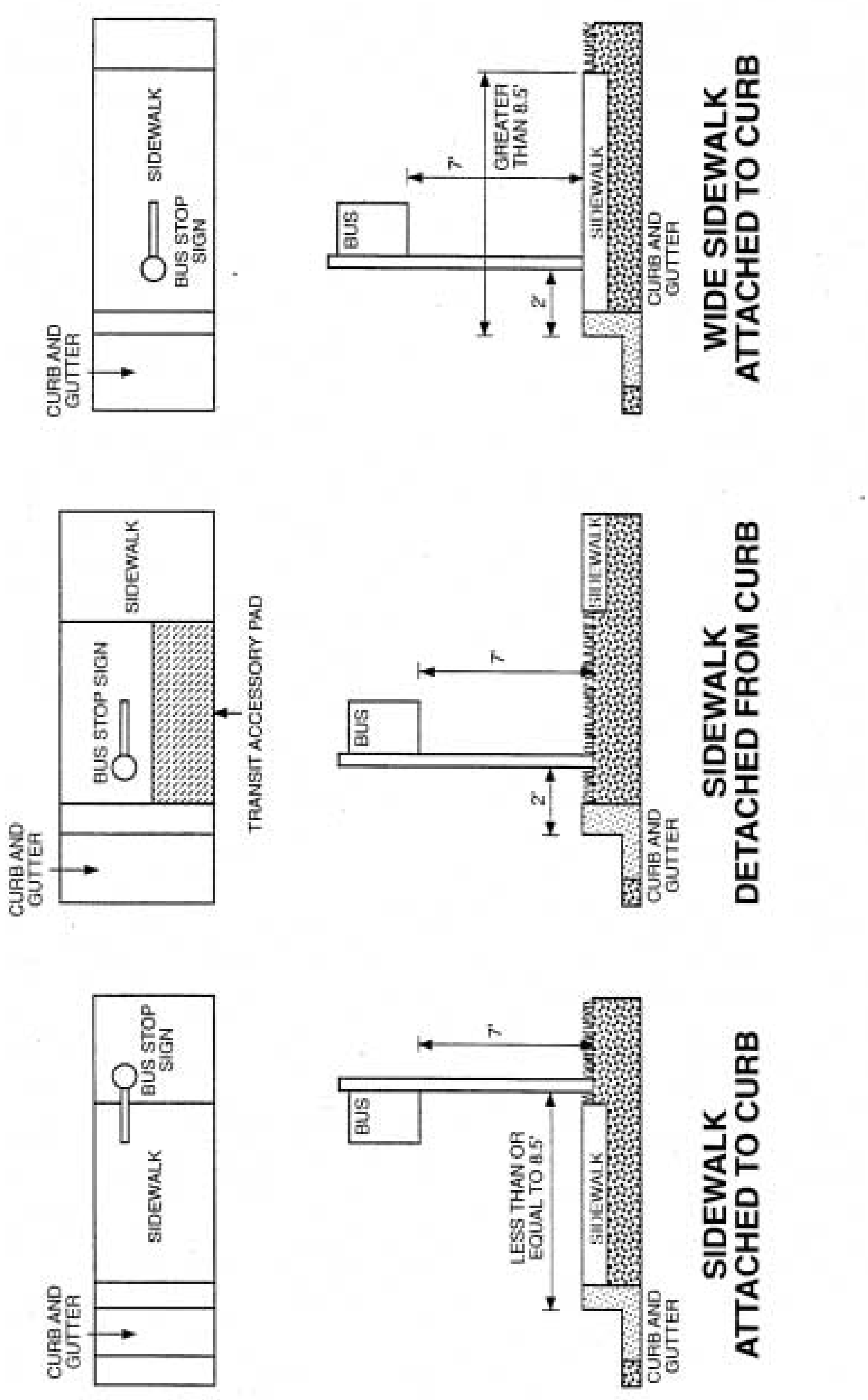


FIGURE 3.3-14

Bus Stop Sign Clearances

Section 3.4

BIKEWAYS

DESIGN STANDARDS AND POLICIES
REVISED DECEMBER 1999

CHAPTER 3
TRANSPORTATION

SECTION 3.4
BIKEWAYS

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Figures

SECTION 3.4
BIKEWAYS

3-401 INTRODUCTION

A. Philosophy of Bikeway Planning and Design

The City of Scottsdale is committed to providing an extensive, connected, and functional bikeway system. The primary purpose of the bikeway system is to provide an alternate means of personal mobility and access to varied destinations.

Bicycle transportation can be used for professional/commuting, social/recreational, or fitness/health purposes. Facilitating this alternative to the SOV by providing a bicycle-friendly city can:

- Replace the use of cars for many short trips
- Help reduce traffic congestion, air pollution, & demand for parking
- Benefit those who cannot drive or cannot afford a car
- Provide healthy recreation for families & all ages
- Help maintain Scottsdale as a livable city with an outdoor lifestyle

Planning for bicycle transportation should be approached as any conventional transportation planning where the same factors of access, convenience, safety, cost, efficiency, travel demand, connections, and engineering considerations all apply. In addition, unlike motor vehicle drivers, plans must accommodate cyclists ranging from children to elders, and individual cyclists present a broad cross-section of needs and skill levels. Different types of facilities need to be designed and provided to accommodate this wide user demographic and their various purposes for making trips.

B. Components of Bikeway System

Bike Lanes are an integral section of a roadway which is marked for exclusive bicycle use. Bike Lanes are always one-way.

Bike Routes may include shared streets, bike lanes, or multiuse paths, in any combination. Routes may be designated by signing or by placement on a map.

Bikeways can be any combination of shared-streets, bike lanes, bike routes, or multiuse paths, and can be designated by signing, mapping, or consistent public use.

Grade-Separated Crossings are underpasses or overpasses, which serve to isolate motorized and non-motorized traffic from each other at points of intersections.

Multiuse Paths are paved pathways set aside for the exclusive use of human-powered travel. They are clearly separate from the road infrastructure. Paths are shared with skaters and pedestrians. In general, multiuse paths are intended for two-way traffic.

Multiuse Trails are unpaved and designed primarily for equestrians. However, trails are also open to bicycle and pedestrian travel. See Section 7-3 for trail information.

Shared Streets may not have a designated bicycle travel facility, but are open to bicycles. This includes all public streets, unless specifically posted to prohibit cyclists. While the suitability of particular streets will vary -often according to the skills and preferences of the individual cyclist- the basic street grid will always provide the major foundation for bicycle travel.

C. Documents and References

The following publications or their current revisions are to be used in conjunction with the design criteria in this book when designing bicycle or multiuse paths for the City of Scottsdale:

American Association of State Highway & Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities. (New edition in 1999)

Arizona Department of Transportation (ADOT) Arizona Bicycle Facilities Planning and Design Guidelines.

City of Scottsdale Bicycle/Pedestrian Transportation Plan, Adopted 1995.

City of Scottsdale Circulation Element of the General Plan, 1991.

City of Scottsdale Design Standards and Policies Manual, Section 3.4, Bikeways, 2000.

City of Scottsdale Supplement to MAG Uniform Standard Specifications for Public Works Construction.

City of Scottsdale Zoning Ordinance, Section 9.100.

Manual of Uniform Traffic Control Devices (MUTCD) Section IX, Traffic Controls for Bicycle Facilities. (Revised manual to be issued in 2000.)

Maricopa Association of Governments Regional Bicycle Plan, 1999.

Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction.

3-402 PLANNING

A. Location

It is a goal of the Scottsdale Bikeway System to provide facilities on a minimum of a:

- Half-mile grid south of Shea Blvd.
- One-mile grid between Shea Blvd. & the CAP Canal
- Two-mile grid north of the CAP Canal

Providing equal grids for both on- and off-street types of bikeways is to be encouraged, as that will accommodate the widest possible range of users, purposes, and trip destinations. The Circulation Element of the 2000 General Plan contains maps of the planned on-street and off-street bikeway systems.

B. Facility Selection: On-Street

Bike Lanes are the most desirable facility for any street with a classification of minor collector or higher. For these streets with higher volumes of traffic, the classification of a street will determine its cross-section. Parkways, major arterials, minor arterials, major collectors, minor collectors, and certain special neighborhood and rural streets have standard cross-sections that include bicycle lanes. Bike lanes would, therefore, be included on these streets whenever they are built or reconstructed. These cross-sections are given in Section 3.1.

For streets that are needed to provide a connection for local or regional bikeway systems, but where a full cross-section with bicycle lanes cannot be accommodated, the following measures should be considered: (Listed starting with the most desirable.)

- Edge line stripe with route signs
- Edge line stripe with no signs
- Route signs with no edge strip

C. Facility Selection: Off-Street

In planning for off-street multiuse paths, the following hierarchy should apply, starting with the most desirable:

- ten or twelve foot multiuse path, well separated from streets, & in a natural setting
- ten or twelve foot pathway, set off from the street by at least ten feet of landscaping
- ten or twelve foot multiuse path protected from the street with a traffic barrier & railing.

Connections between different types of facilities can be very important to insure an efficient and functional system. In places, multiuse paths may be used to connect sections of roadways that would otherwise dead-end. However, it is critical not to attempt to substitute a path or a sidewalk where bike lanes are warranted. Bike lanes allow direct, higher-speed travel for cyclists, unimpeded by pedestrians. Bike lanes are also one-way, going with the adjacent traffic. Paths are typically two-way; so designing a path to connect properly with bike lanes would require very careful study and design. The major problem is that people may end up going the wrong way (against traffic) in one of the bike lanes.

Opportunities to provide bicycle access may occur in conjunction with public or private development, greenbelts, canal banks, flood control projects, vista corridors, or anyplace with available open space or right-of-way. It is the intention of Scottsdale's bicycle planning efforts to remain flexible and open to new opportunities.

D. Easements, Dedications & Abandonments

In the case of on-street facilities, the bike lane or route is typically located within the street right-of-way (ROW). Sometimes on-street facilities may need to be connected with short sections of paved path. An example of this would be cul-de-sacs that have only one direct access to the public street system. Sometimes the cul-de-sac street can be connected to allow bicycle and foot access to reach adjacent streets, paths, trails, or property.

If a private, gated community will cut off functional access for cyclists, means should be explored to maintain a public use easement on the streets and through the gates for pedestrians and cyclists.

For off-street paths, ROW may need to be obtained from development stipulations, or purchased. Any easements or dedications for paths should include a clear statement of maintenance responsibilities: for the actual concrete path, any adjacent landscaping or lighting, and for maintaining proper grades and drainage along the path. Dedication of right-of-way or of public use easements for paths must be noted in the stipulations and on the site plan. This should occur in the Project Review process for new developments.

If the classification of an existing or planned street is proposed to be changed, or a street easement or ROW proposed for abandonment, present and potential pedestrian and cyclist connections should be reviewed. The proposed change shall be evaluated against the needs of the bicycle program. If needed, some means of bicycle and/or foot access, such as a public use easement, should be obtained.

3-403 FACILITY DESIGN

GENERAL COMMENT

While every effort has been made to ensure the accuracy and completeness of these guidelines, the City of Scottsdale shall not be held responsible for any errors or omissions. It shall be the sole responsibility of the design engineer to ensure a proper design and the accuracy and completeness of construction documents containing his or her signature.

A. Shared Streets and Bike Routes

It should be assumed that cyclists will ride on all streets, unless such use is expressly prohibited and posted. Many neighborhood streets function quite well as bikeways with no additional signing or marking. If these streets are needed to complete some part of the bikeway system, or to provide a connection for cyclists, the street may be designated by edge stripes, signs, or on a map.

Since cyclists will tend to use the right side of the outside lane, this area should always be built and maintained to accommodate that use. Drainage grates should be designed and installed in a manner that will not trap wheels. Longitudinal cracks, potholes, rough paving, etc. should be eliminated.

B. Bike Lanes

Streets such as parkways, major arterials, minor arterials, major collectors, minor collectors, and certain neighborhood and rural streets have cross-sections that include bicycle lanes. These cross-sections are in Section 3.1.

COS lanes shall be a minimum of four feet of asphalt from the center of the lane stripe to the edge of the concrete gutter pan. A solid six-inch white stripe is used to mark off the bike lane. An alternative method is to combine the lane and gutter pan as one concrete strip. In these cases it is desirable to exceed the four-foot minimum, as measured to the face of the vertical curb. Figures 3.4-6 and 3.4-7.

Bridges, tunnels, or any grade separation structure, should allow the full width of the physical improvements including standard bike lanes. Also note that most surface streets, even without designated bike lanes or shoulders, usually allow for some “shy distance” or permit an emergency move off the road. Bridges and tunnels with solid barriers alongside often become dangerous constriction points for bicycle travel. Therefore consideration should be given to maintaining extra width on bridges and in tunnels even if the street does not have bike lanes.

In rural areas, a paved shoulder can serve the function of a bike lane, in which case it should have a minimum of five feet of paving. A bicycle lane can also be delineated with striping between an area for parallel parking and a traffic lane. In this case the bicycle lane should be at least five feet. Figure 3.4-6.

Whenever a half-street is constructed, if the ultimate street classification has a cross-section with bike lanes, then the half-street construction should also provide a bike lane on each side.

Parking should not be allowed in marked bicycle lanes.

Raised pavement markers or curbing should never be used to delineate bike lanes.

Figures 3.4-6, 3.4-7, and 3.4-8 give example of bike lane configurations for various situations.

For additional information concerning bike lanes and routes not covered in this manual, please refer to the AASHTO Guide for the Development of Bicycle Facilities, 1999.

C. Multiuse Paths

Operation and use of multiuse paths are covered by COS Revised Code, Article IV, Chapter 17.

COS Standard Details for Multiuse paths are found in Figures 3.4-1, 3.4-2. 3.4-3, & 3.4-4.

For additional information not covered in this manual, please refer to the AASHTO Guide for the Development of Bicycle Facilities, 1999. E.G., this guide provides information on minimum radii for curves, grades, sight distances, and stopping sight distances under various conditions.

City of Scottsdale multiuse paths shall have a(n):

- Minimum design speed of 20 mph.
- Typical width of ten feet with a two-foot shoulder on each side.
- Width of eight feet where paths can be paired so each can have one-way travel.
- Width of twelve feet where heavy use is expected, especially with a high percentage of pedestrians/skaters.
- Medium broom finish on the surface. It is desirable to provide traction, but not to a degree that impedes skaters
- Material for the shoulders that can allow for recovery if a user runs off the path. Substances such as turf, decomposed granite, exposed aggregate, or very low shrubs/grasses are appropriate. No spiny/thorny plants.
- Area clear of fixed objects such as poles or tree trunks for another three feet beyond the shoulder
- Handrails for paths or bikeways should 54 inches in height and be flared at the ends.
- Vertical clearance of eight feet over the path and shoulder areas. Figure 3.4 –10.
- Grades of five percent or less. Where this is not feasible, refer to the AASHTO Guidelines. The Transportation Dept. will make the final decision. Maximum side slope is two percent.
- Alignment which is as linear as possible. Avoid compound curves. Unnecessary "meandering" reduces the effective width of the path, can create sight distance problems, and increases possibility of users running off the path. Figure 3.4-9B.
- Adjacent grades should always direct water away from the path surface. Note in Figure 3.4-9A the small swale on the up slope side.
- Provision in tunnels to keep nuisance water off the path, and allow the water to rapidly drain or be removed. One solution is a small channel constructed with a sloping side, built on one side of the tunnel. Sump pumps are needed in areas prone to flooding. Figure 3.4-11.
- Lighted tunnels
- Path ramp design where the pan for any curb ramp shall be as wide as the path. The ramp should be aligned with the path, and not require users to make sudden swerves, or to be directed towards oncoming traffic. Figures 3.4-12A & 12B.

<u>Other special conditions</u>:
Every attempt should be made to avoid having a path adjacent to a street. If this is unavoidable, try to achieve a separation of at least five feet, with landscaping. If the path and street separation will be less than five feet, then a combination vehicular and bicycle railing and traffic barrier must be used. The top of the barrier and rail must be at least 54 inches. These railings perform the dual function of retaining both vehicles in the street and cyclists on the path. Figure 3.4-9A.

Grade-separated crossings, either over or underpasses, for path/street intersections are highly desirable, where feasible.

However, the majority of these crossings will be at-grade. Certain design practices can greatly improve these at-grade crossings, whether or not they are mid-block, controlled intersections, or driveway exits. Some practices found helpful in Scottsdale are making the crossing a contrasting material, striping each side of the crossing, keeping median bullnoses out of the path, or elevating the path on a speed table. Figures 3.4-1, 3.4-12A & B, 3.4-13, 3.4-15, 3.4-16.

D. Riding Surfaces

Drain grates can be a serious potential hazard to trapping wheels. Careful attention should be paid to the choice and installation of drain covers. There are MAG and COS Standards that are applicable. Gaps between the grate and its frame should not exceed ¼ inch.

Paving for bike lanes should meet MAG standards for surface smoothness of asphalt paving.

Rumble strips, raised pavement markers (rpms), or raised curbs should never be used to delineate bike lanes, multiuse paths, or in bikeway crossings.

Multiuse paths will have a medium broom finish. The width of expansion joints should be minimized, and the joints tooled with a small radius.

3-404 TRAFFIC CONTROLS

A. Signs and Markings

Traffic control devices for cyclists, whether they are for an on- or off-street system, must adhere to the same five basic requirements as for motorists: Fulfill a need, command attention, convey a clear, simple meaning, command respect from users, and give adequate time for a proper response.

The use of colors should conform to code specificaitons for signs and markings: Yellow – General Warning, Red – Stop or Prohibition, Blue – Service Guidance, Brown – Recreation, Black – Regulation, White – Regulation.

All regulatory, warning and route marker signs shall be provided in accordance with the standards in the Manual on Uniform Traffic Control Devices, Section IX. In addition, the City of Scottsdale has developed some signs for particular situations, see Figures 3.4-1, 3.4-2, 3.4-4, and 3.4-7 for COS Details # 2281, 2282, and 2284.

Signing and marking for bike lanes is shown in Figures 3.4-6, 3.4-7, and 3.4-8. Signing and marking for paths is shown in Figures 3.4-1, 3.4-2, 3.4-4, 3.4-13, and 3.4-15. Other information is in the AASHTO Guidelines.

For bike lanes, markings shall consist of a directional arrow and a bike/rider symbol. In urban areas, pavement markings shall be placed 50 to 75 feet after every major intersection, or at ¼ mile intervals, whichever is less. In rural areas, the distance may change as judged appropriate by the COS Transportation Dept.

Where a bike lane continues past the left side of a right-turn-only lane, a pair of symbols shall be placed in that continuation.

On leaving an intersection, the lane stripe should start at the crosswalk or where the crosswalk would be. Approaching an intersection, if the volume of right turns is heavy, then the stripe should be dropped 50 -75 feet before the intersection.

Mulituse path striping is shown in Figure 3.4-2, COS Detail # 2282.

Whether for lanes, routes, or paths, any paint or thermoplastic stripes or markings should be reflective and highly non-slip.

B. Detours & Construction

Public information:
Any signage, publication, map, web posting, public service announcement, or other information dealing with any construction closure, restriction, or change, shall always include any expected effects on cyclist or pedestrian movements. This includes, but is not limited to, changes in the operation of sidewalks, multiuse paths, bike lanes, or any other bikeways.

Ideally, detours would be found or built, and well signed. Bikeway detours should only be used when the same type of facility can be provided, e.g., a bike lane directed to other lanes or shoulders, or to a suitable shared street. Path detours should be directed to another path or suitable sidewalk, not to an on-street facility.

Shared Streets, Bike Lanes, and Multiuse Paths:
If a bike lane is closed, it shall be signed "Bike Lane Closed" and also signed "Bikes on Roadway" for the portion where cyclists will be forced to use the traffic lane. This applies to shoulders with high bicycle use, as well as cases where the work is confined to the bicycle lane.

If the traffic lanes are narrowed for construction detours, so that a car and bicycle cannot safely pass side-by-side, then cyclists and motorists should be directed as above.

Special attention needs to be paid to work, such as utility, which takes place only in the bike lane or shoulder area. Sometimes precautions are ignored, because the vehicular traffic is not affected. However, proper signing and barricading, with lights for night warning, is still essential. Irregular surfaces, such as raised metal plates on shoulders or hoses laid across paths, can be especially hazardous and must always be well barricaded.

Signing and barricading should anticipate night use and speeds up to 25 mph. Barricades and signs should be posted at points where people are able to choose an alternate route.

When not in use, barricades, signs, etc., should not be placed or stored in bike lanes or on shoulders or paths.

Bike lanes/shoulders shall always be restored to an excellent paving condition. MAG Standard 321.5.4, Asphalt Base and Surface Course, should apply.

3-405 PARKING

A. Location

The City of Scottsdale Zoning Ordinance, Section 9.100, specifies bicycle parking requirements.

Bicycle parking shall be located within fifty feet of the main entrance(s), in a convenient, highly visible location. Ideally, the bicycle parking will be more convenient to destinations than the motor vehicle parking. On a site with several businesses, bike parking should be dispersed so as to be convenient to individual entrances. A portion of the required parking may be located by an employee entrance.

The Zoning Code gives the requirements for the number of bicycle parking spaces for various public and private development. Typically it is 10% of the vehicle parking.

The COS Standard Detail # 2285 bike rack (Figure 3.4-5) is designed to provide:

- Secure support for the entire frame of the bike by allowing numerous contact points with the frame and one wheel, with those points being spread out both horizontally and vertically. These contact points are all in one plane. This helps prevent damage to paint, eliminates metal points that could stick out to cause damage or injury, and the bicycle is prevented from sliding down or flopping over.
- Accommodation of any size or type of bicycle with any type of luggage or equipment. The bicycle does not have to be lifted up or be supported by a kickstand.
- Ease of use, and manner of use, is clear without instructions. (A poor design; e.g., the "ribbon" rack; leads to misuse: this rack is designed for bikes to be placed perpendicular to the rack, but the first person usually places their bike parallel across the openings.)
- Secure locking with any type of lock or cable, including the "U" locks. If the front wheel is removed and repositioned, then it should be possible to lock the frame and both wheels to the rack. The rack should not require that the lock be fastened close to the bicycle chain.

The City rack may be painted, and may be placed on concrete, turf or gravel. It may be used as singles, doubles, or in rows. Each loop accommodates two bikes.

Any substitutions or exceptions must provide the same functions and be approved by the Bicycle Planner.

3-406 MAINTENANCE

On-Street Bikeways will be maintained by Field Services as part of the regular street sweeping and maintenance. Special attention should be given to drain grates, utility covers, and any surface irregularities.

Off-Street Bikeways Responsibility for the maintenance of a new path should be determined at the time of dedication or purchase or granting of easement. This document should be kept by CM&R, Municipal Services, Transportation, & Risk Management.

Regular maintenance should include:

- Sweeping
- Removal of all dirt, graffiti, and pasted material
- Displaying warning signs when water is present or flooding imminent
- Clean-up after flooding
- Litter pick up
- Manual or chemical removal of weeds
- Pruning to maintain proper clearances. See Figure 3.4-10.
- Periodic removal of silt to maintain low flow channels away from path

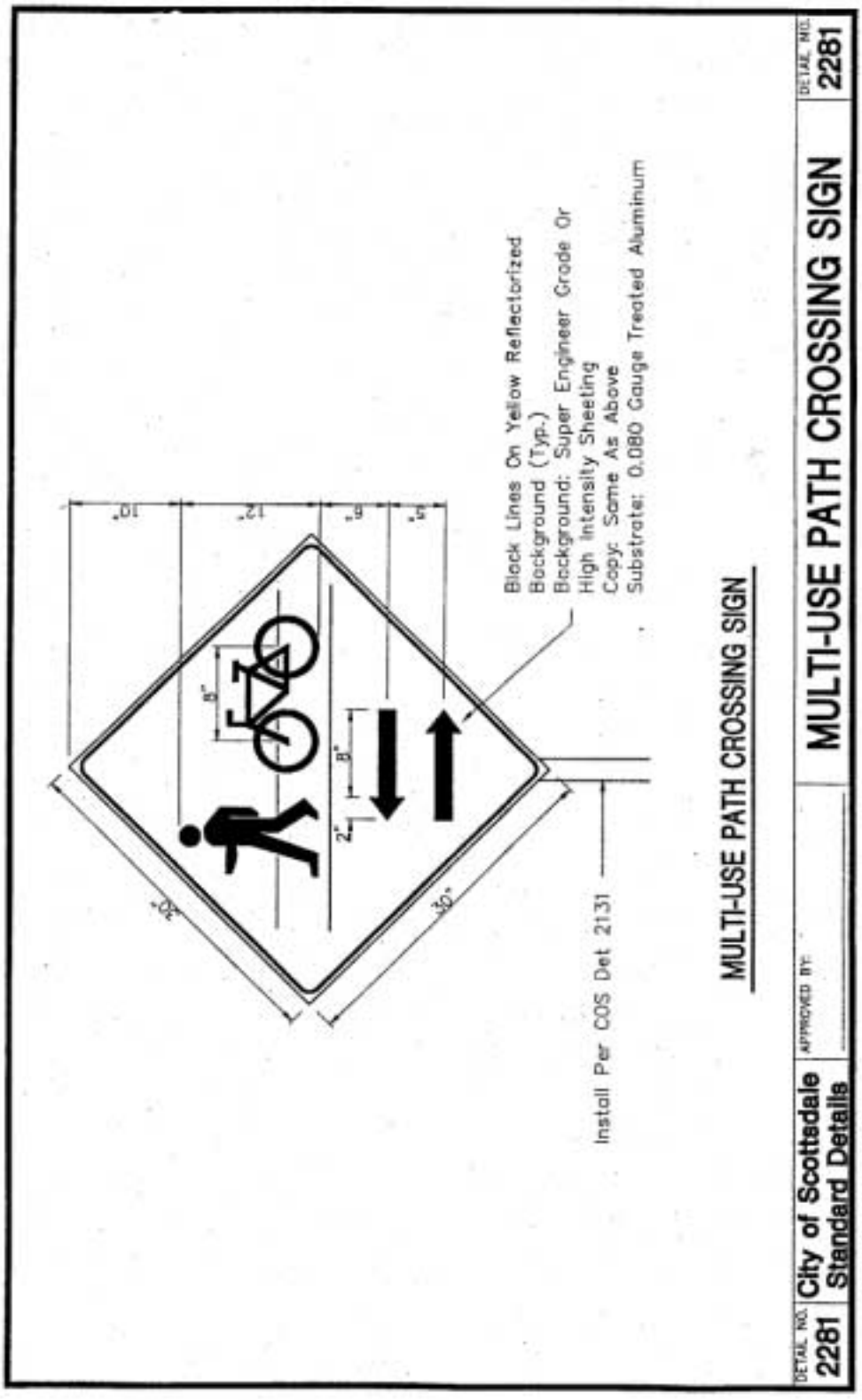


Figure 3.4-1

Multi-Use Pass Crossing Sign

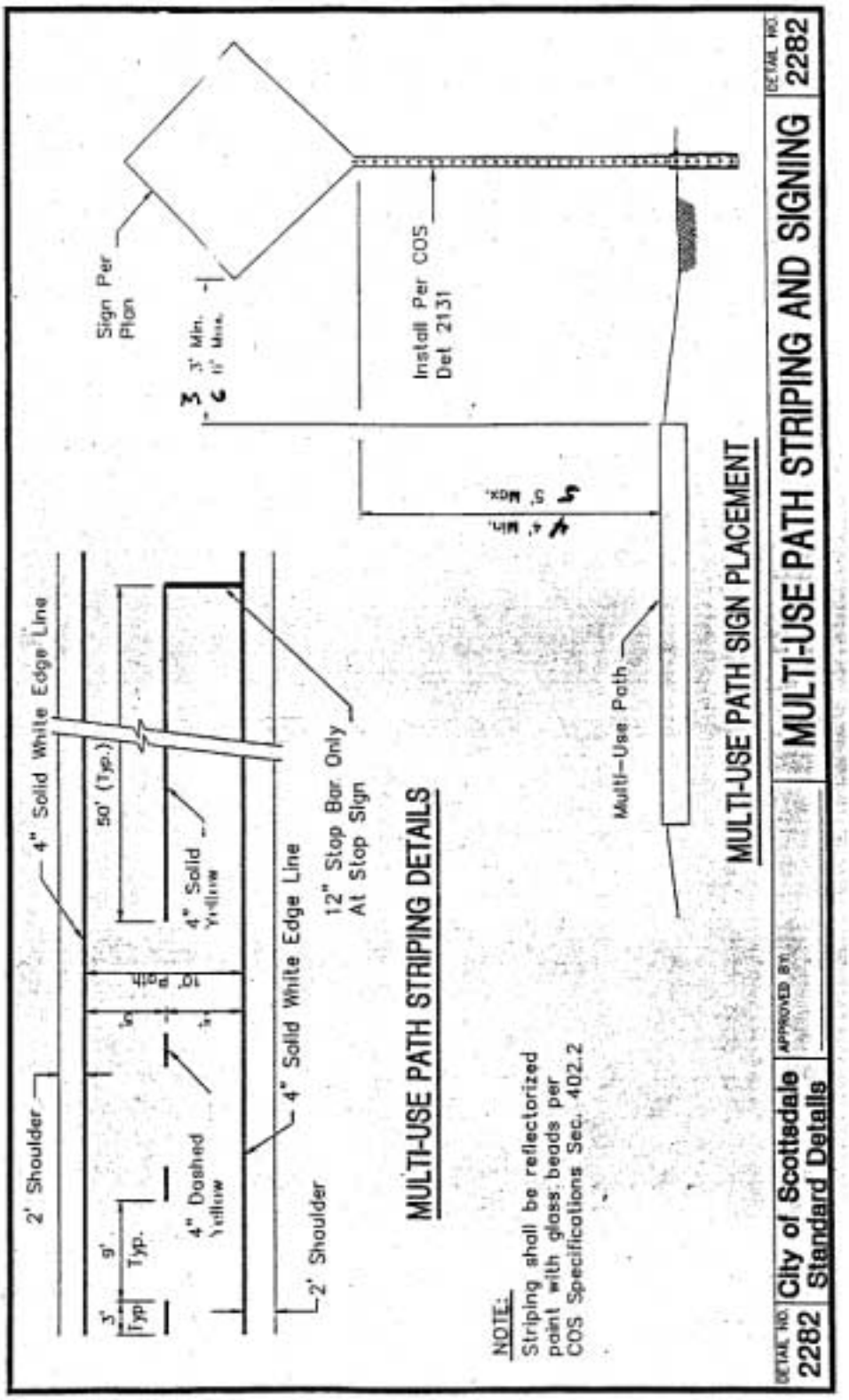


Figure 3.4-2

Multi-Use Pass Striping and Signing

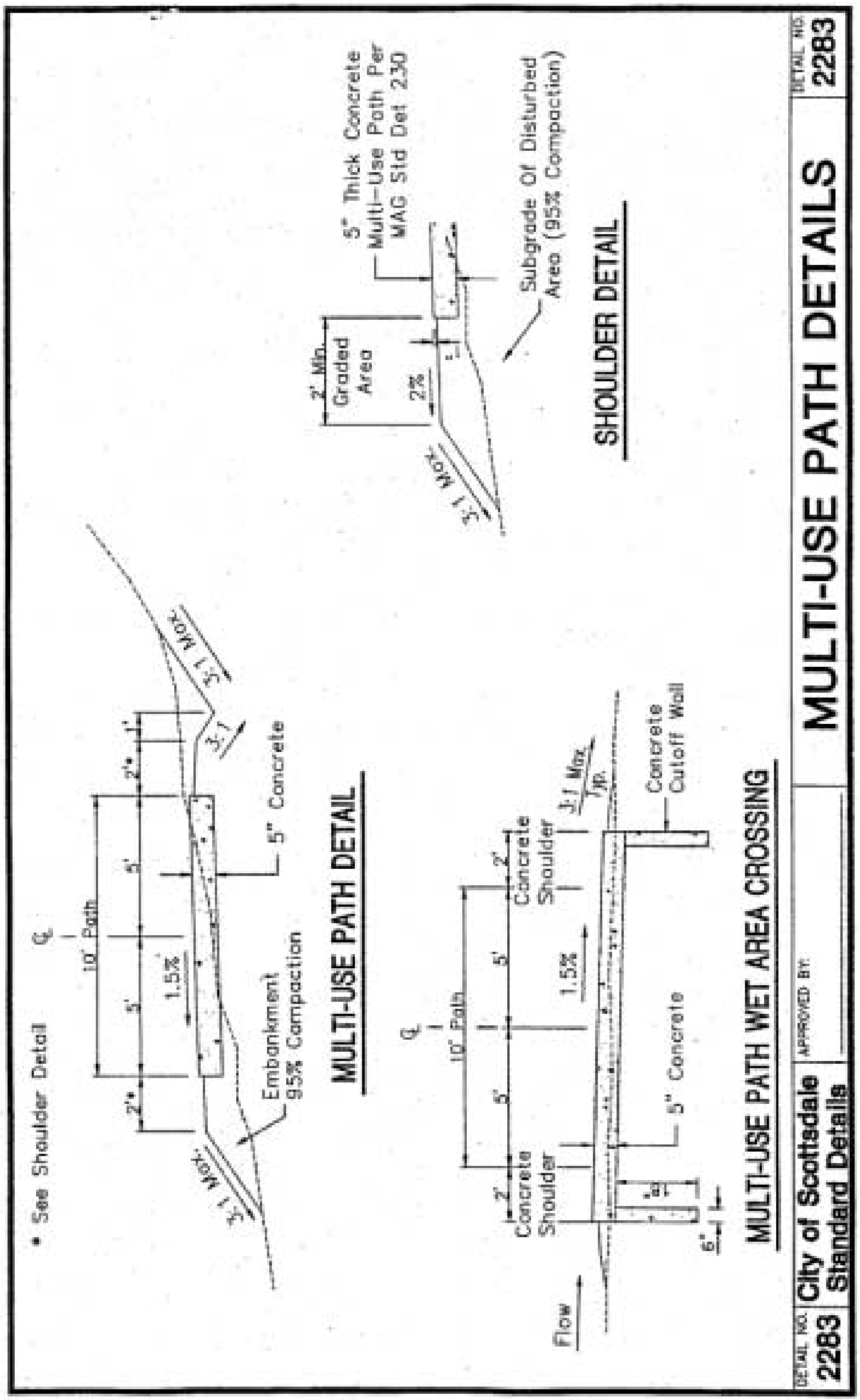


Figure 3.4-3

Multi-Use Pass Details

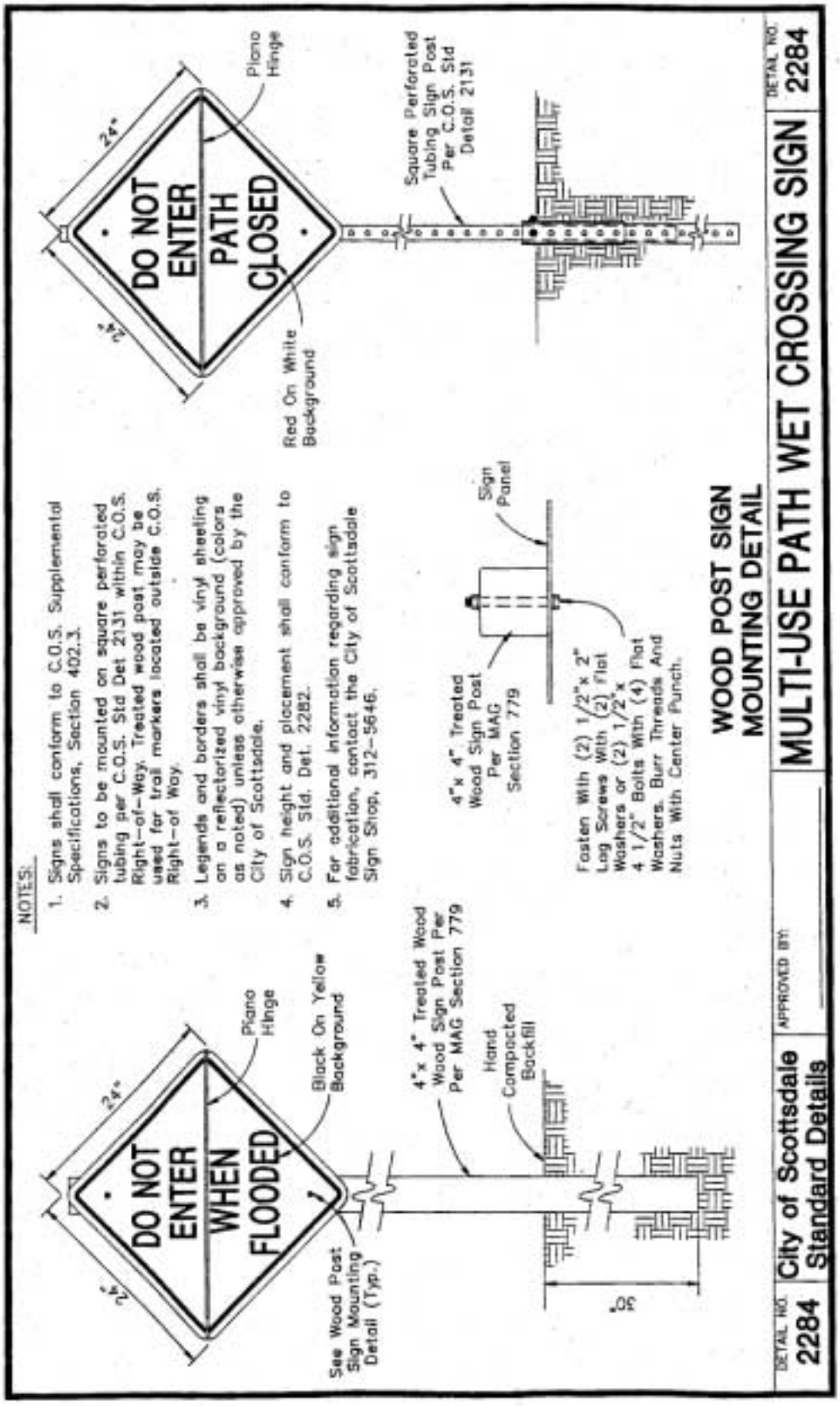


Figure 3.4-4

Multi-Use Pass Wet Crossing Sign

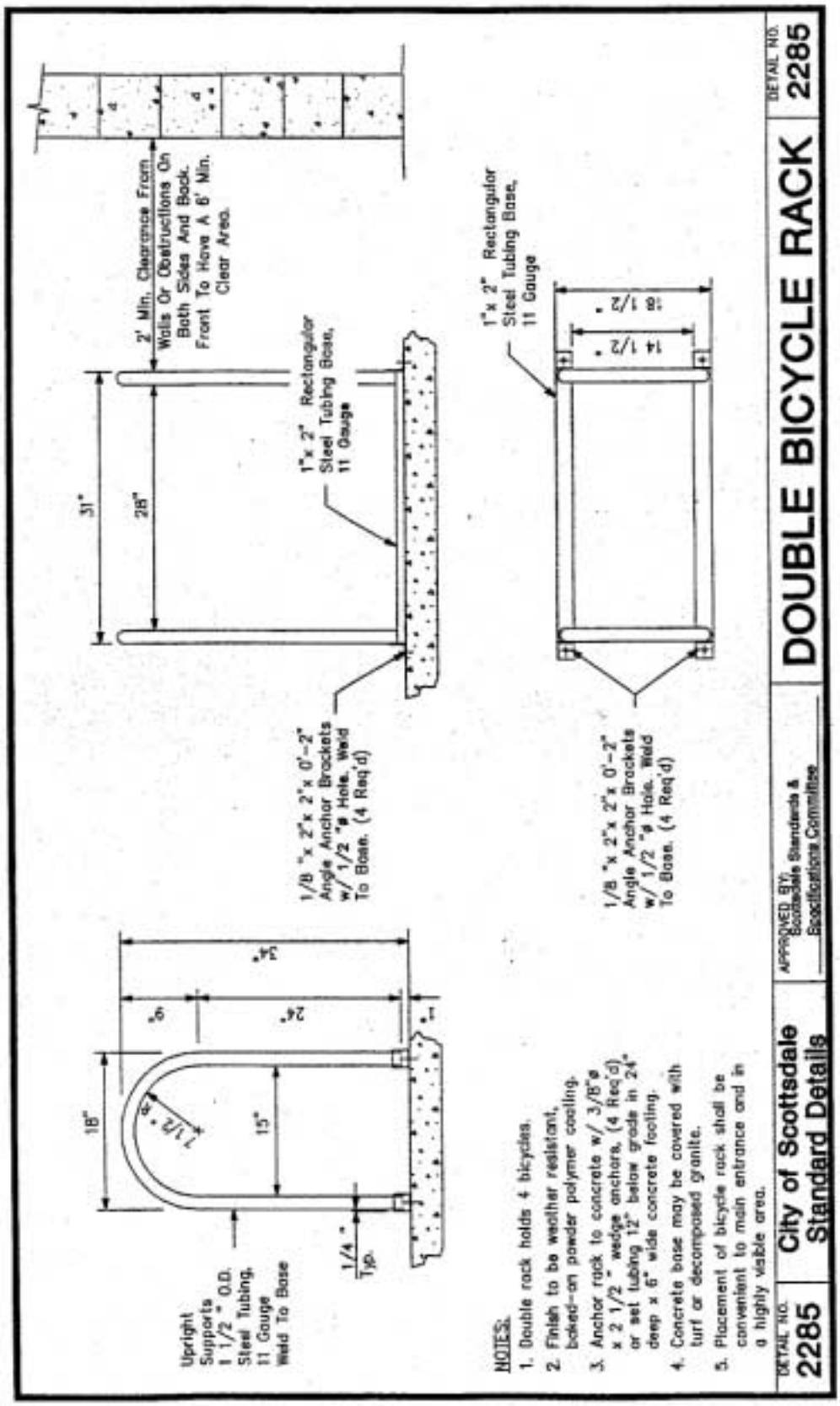
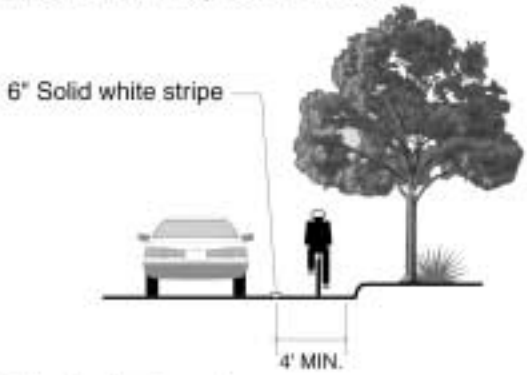


Figure 3.4-5

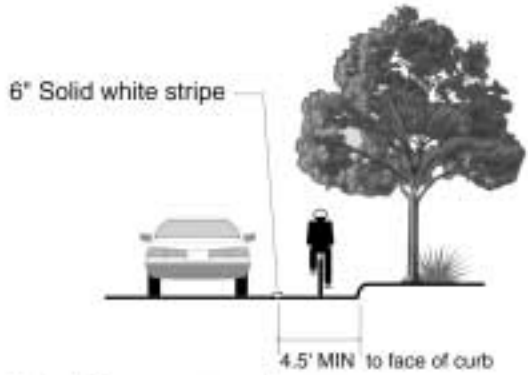
Double Bicycle Rack

Curbed Street
Where Parking is Prohibited



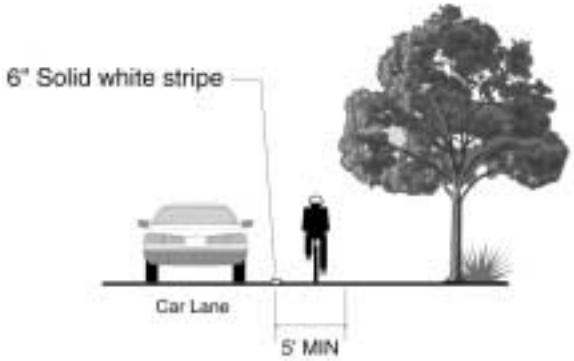
This four foot lane is
exclusive of curb & gutter.

Wide Curb Lane

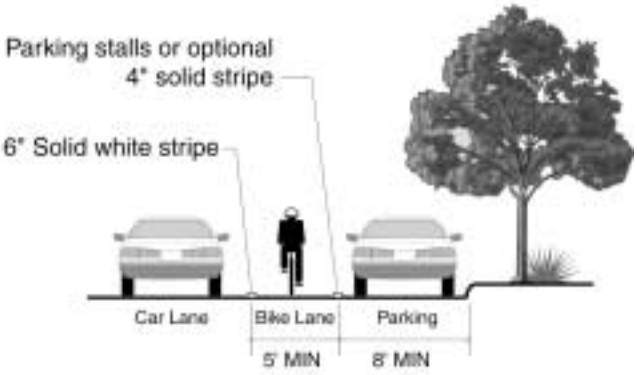


Monolithic concrete curb, gutter
& bike lane. No longitudinal joints.

Street Without Curb or Gutter

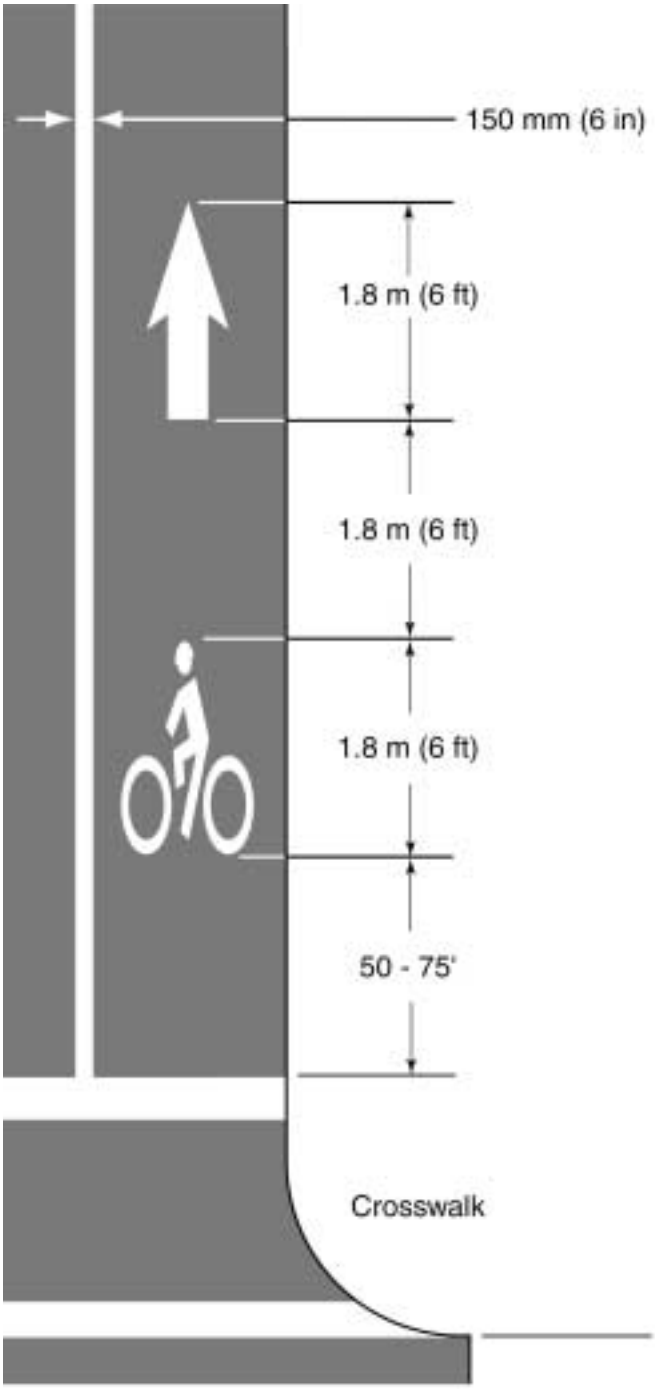


Curbed Street With Parking



Note: These cross sections are compatible
with City street cross sections in Section 3.1.

Figure 3.4-6
Bike Lane Cross Sections



Alternate symbol
for consideration

Figure 3.4-7
Bike Lane Markings – Far Side of Intersection

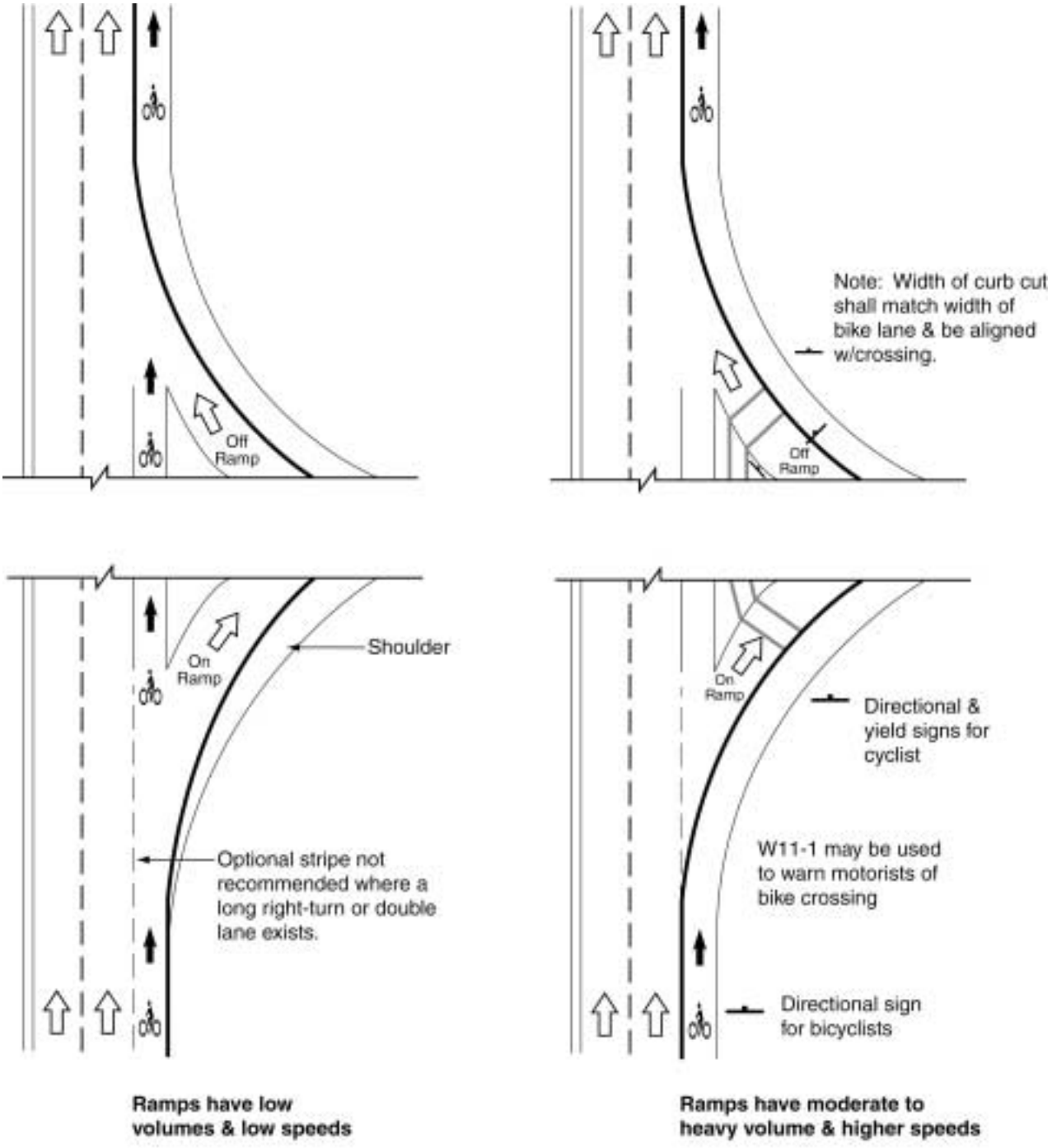
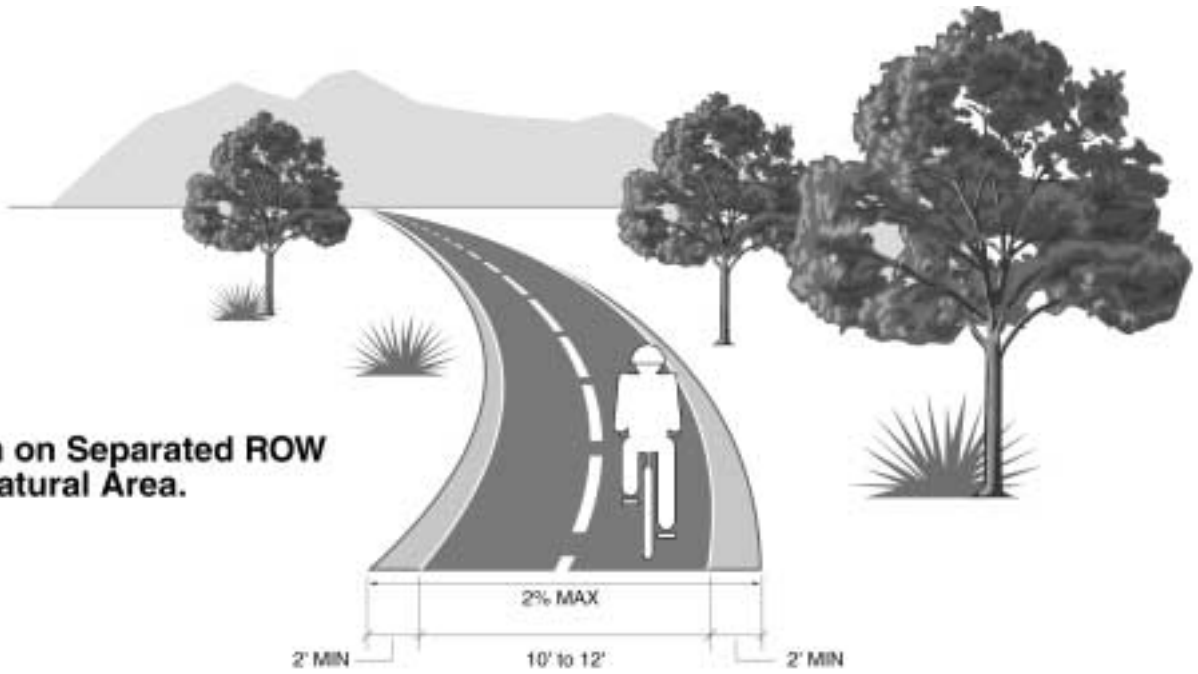


Figure 3.4-8
Bike Lane Ramp Crossings



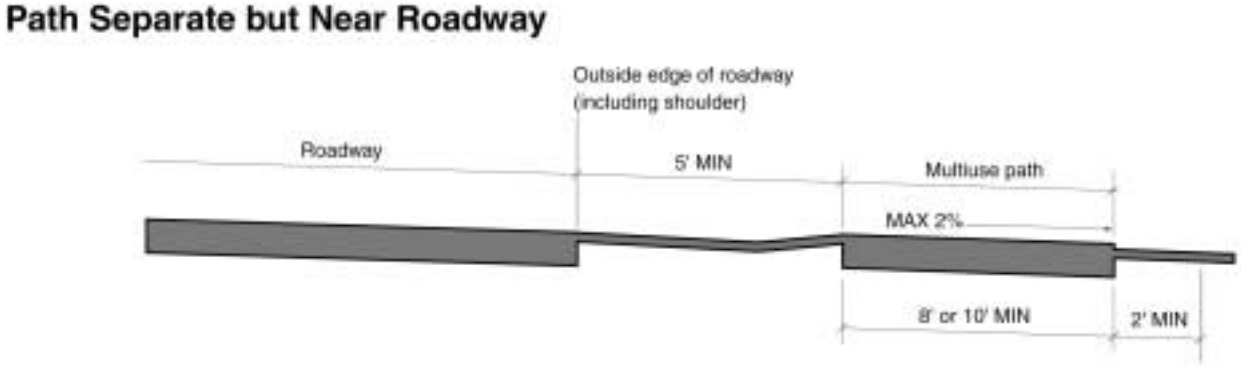
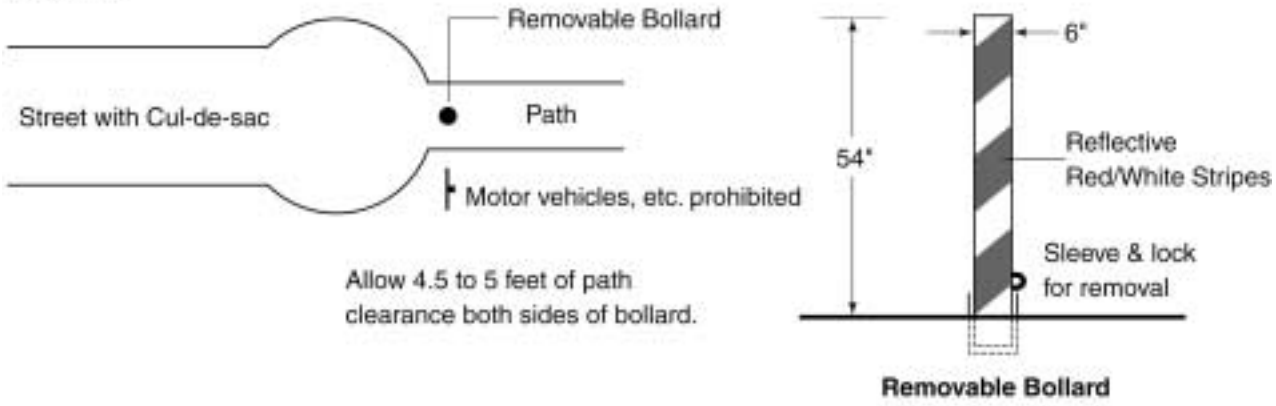


Figure 3.4-9A
Multiuse Path Perspectives

Vehicle Control at Path Entrance Where Needed

EXAMPLE:



Multiuse Path Alignments

Paths shall be constructed to be
as linear as possible. Avoid compound curves.

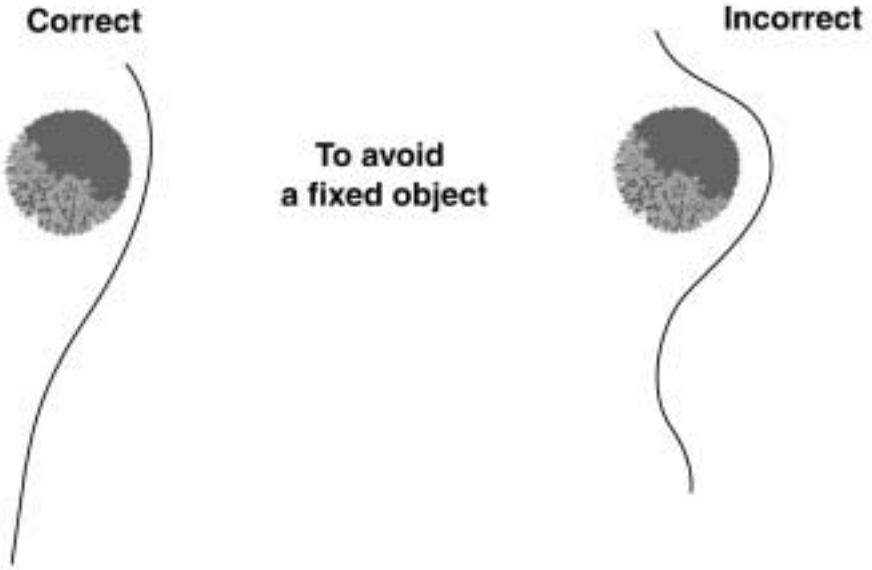


Figure 3.4-9B
Multiuse Path Perspectives

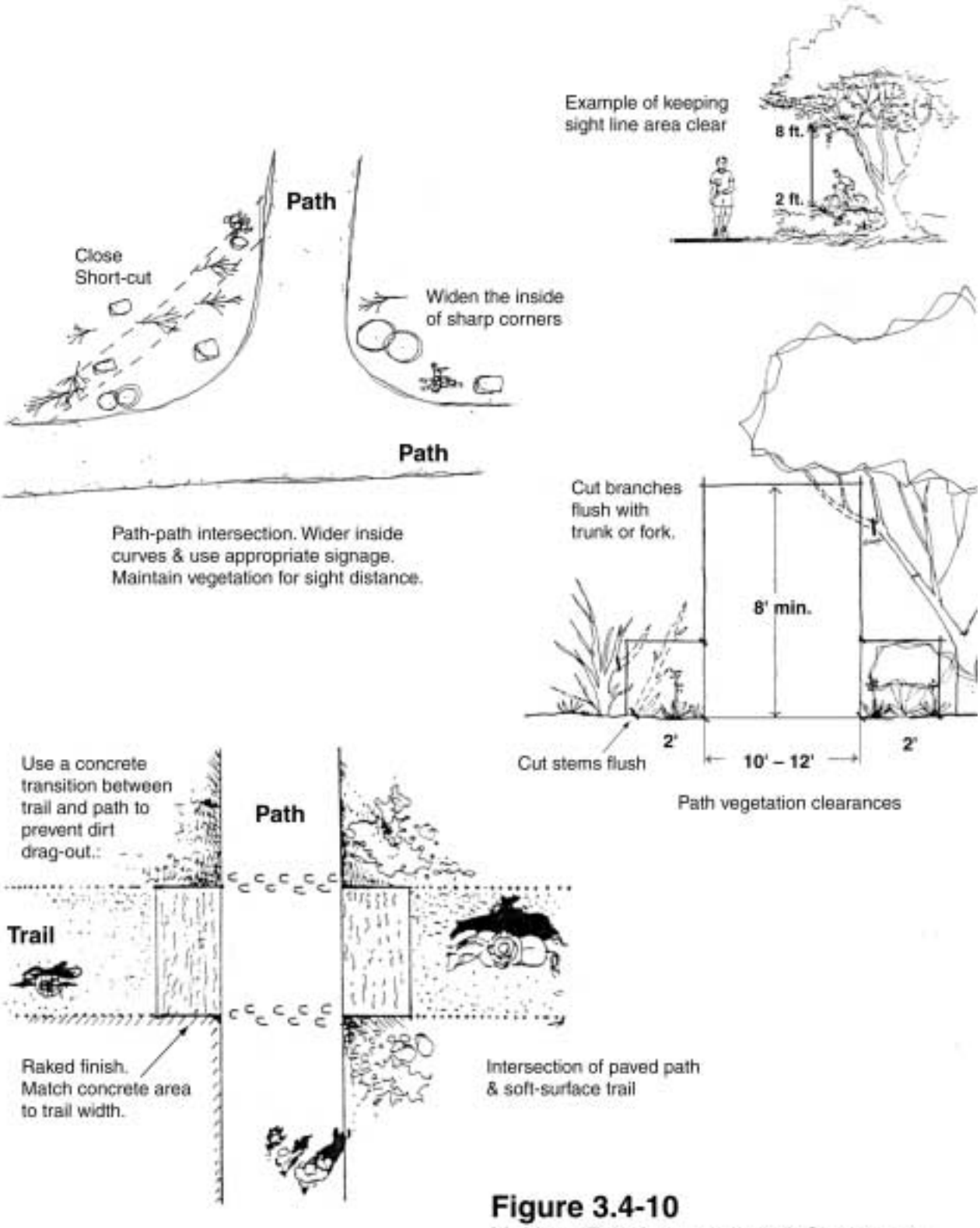


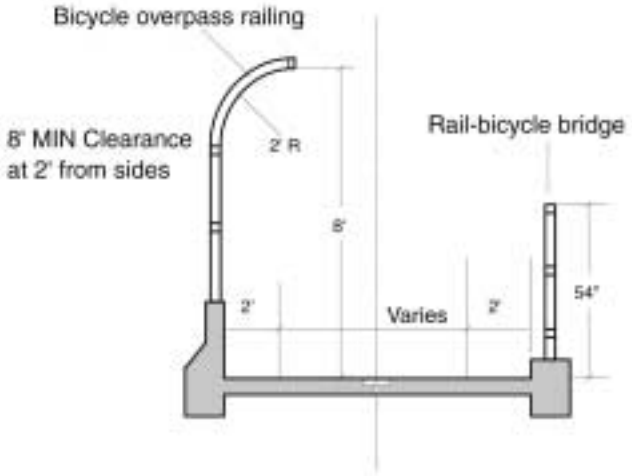
Figure 3.4-10
Multiuse Path Intersections & Clearances

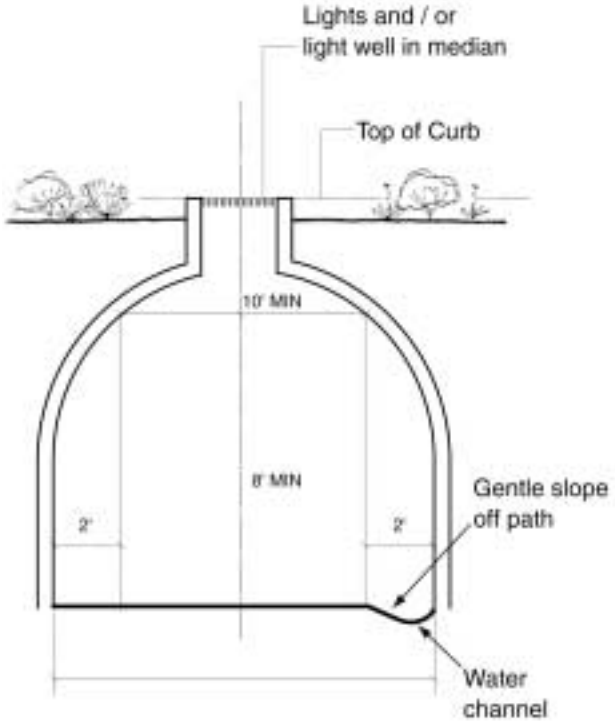
Approach to Overpass

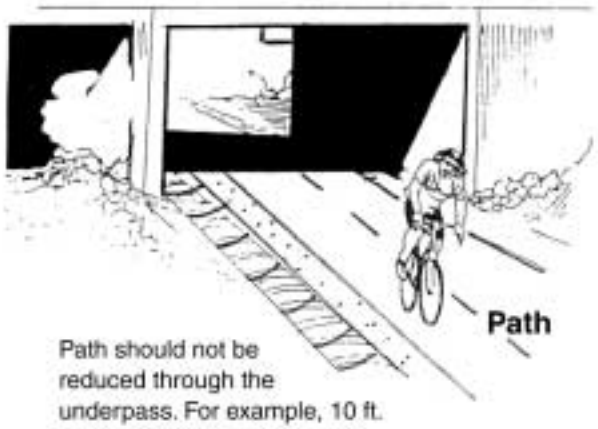
See design standards
for appropriate grades.

Check landing area for stopping
sight distance requirements.
Avoid direct entry into streets.

Multiuse Path Bridge Section



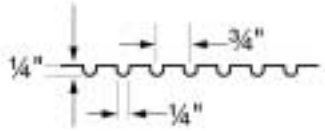




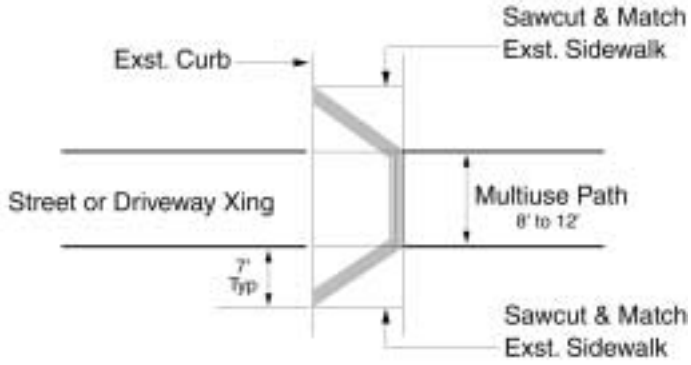
Path should not be
reduced through the
underpass. For example, 10 ft.
plus two 2 ft. shoulders, and
drainage swale as needed.

Figure 3.4-11
Multiuse Path Bridges & Tunnels

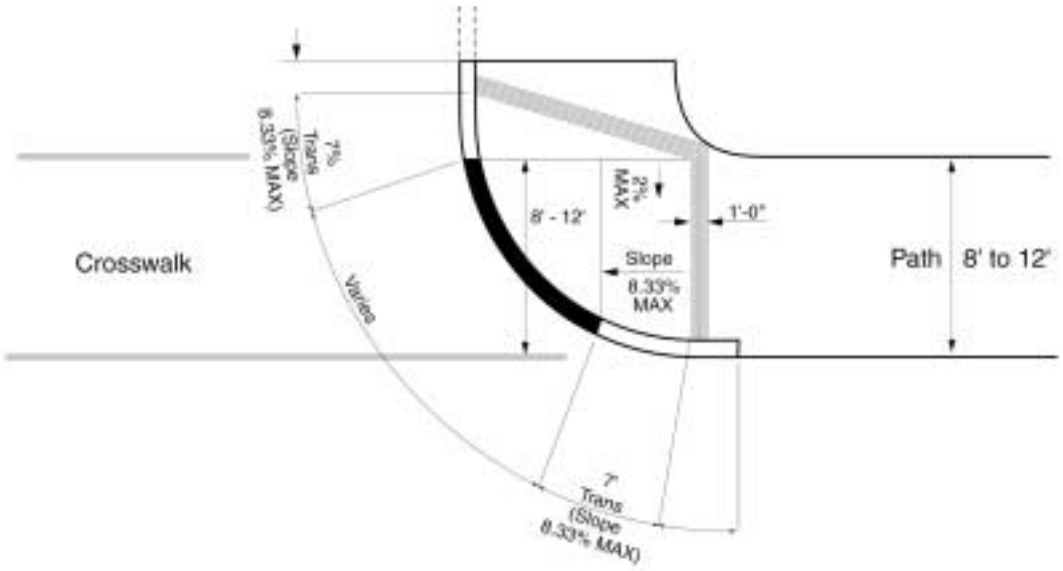
Examples:



Grooving Detail



Path Crossing at Corner Continuing Straight

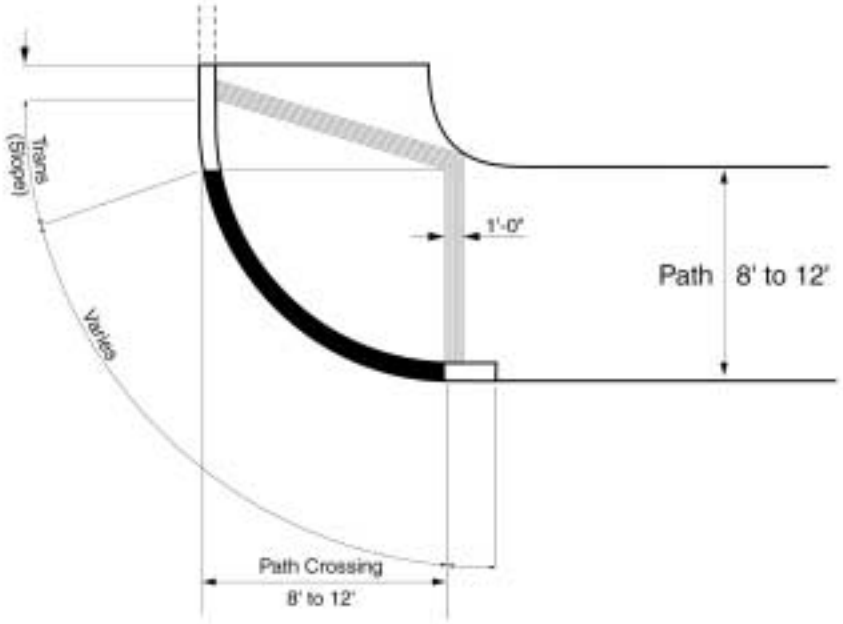


Notes: Where a small elevation change occurs on a path, such as crossing a curb to enter a street, the design shall meet the following:

- The width of the path (minus shoulders) shall equal the width of the center portion of the ramp (minus wings)
- The edges of the path, ramp & any crosswalk shall be a straight line.

Figure 3.4-12A
Ramps for Multiuse Paths

Path Crossing at Corner Then Turning



Path Forced to Come to Corner at Angle

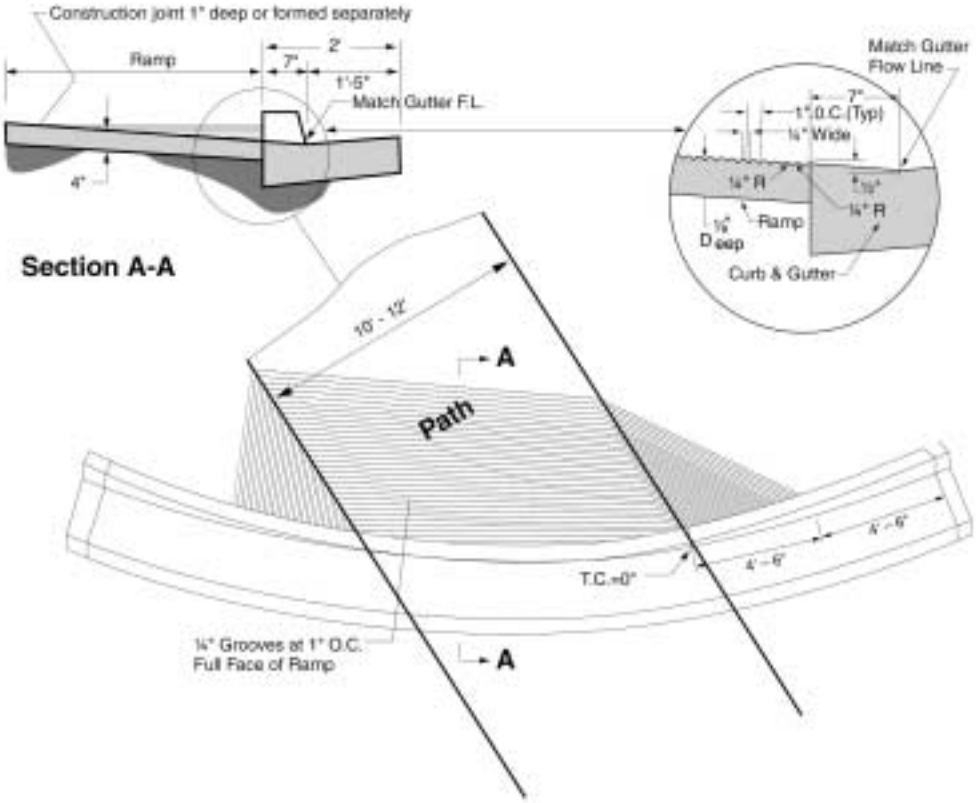
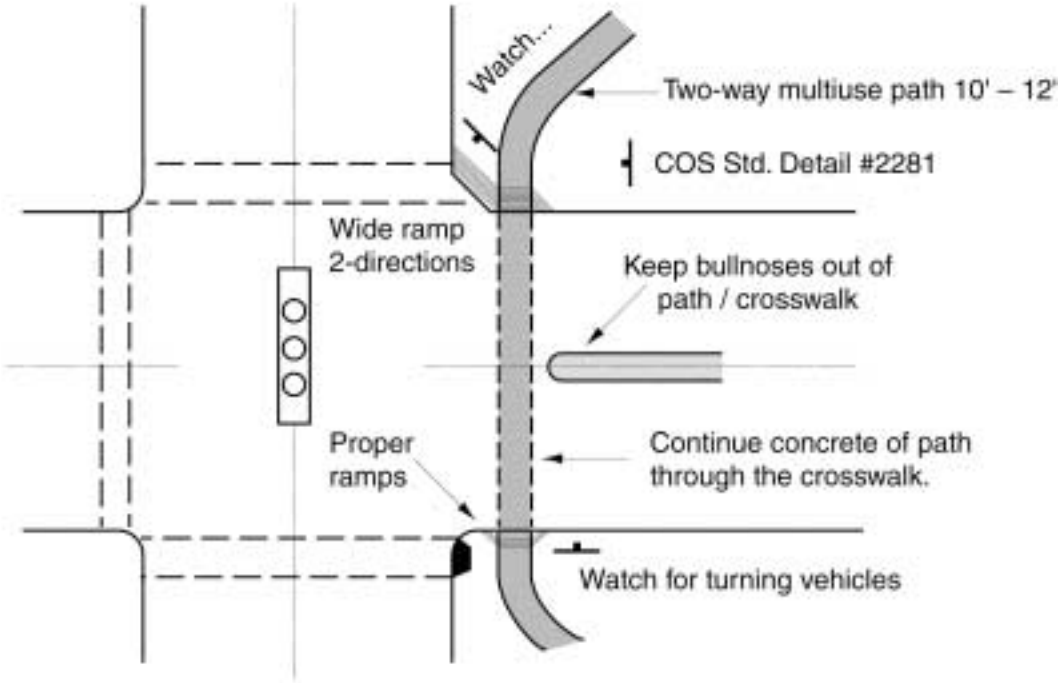


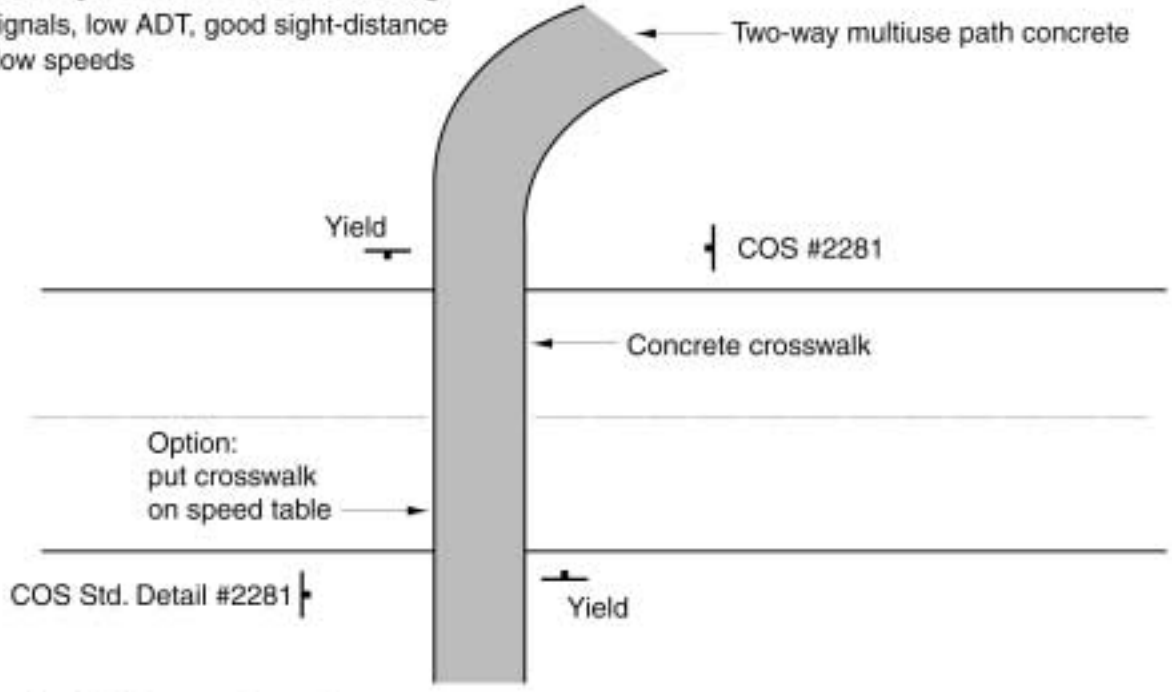
Figure 3.4-12B
Examples of Ramps Options for Paths

Path Crossing at Intersection with signals



Driveway / Midblock Crossing

No signals, low ADT, good sight-distance and low speeds



Note: A midblock crossing on busy, multilane streets will require more safety features, e.g. pedestrian refuge.

Figure 3.4-13
Intersections of Paths & Streets

Safety Rails are Needed Where the Conditions Will Exceed the Below Depicted Limits

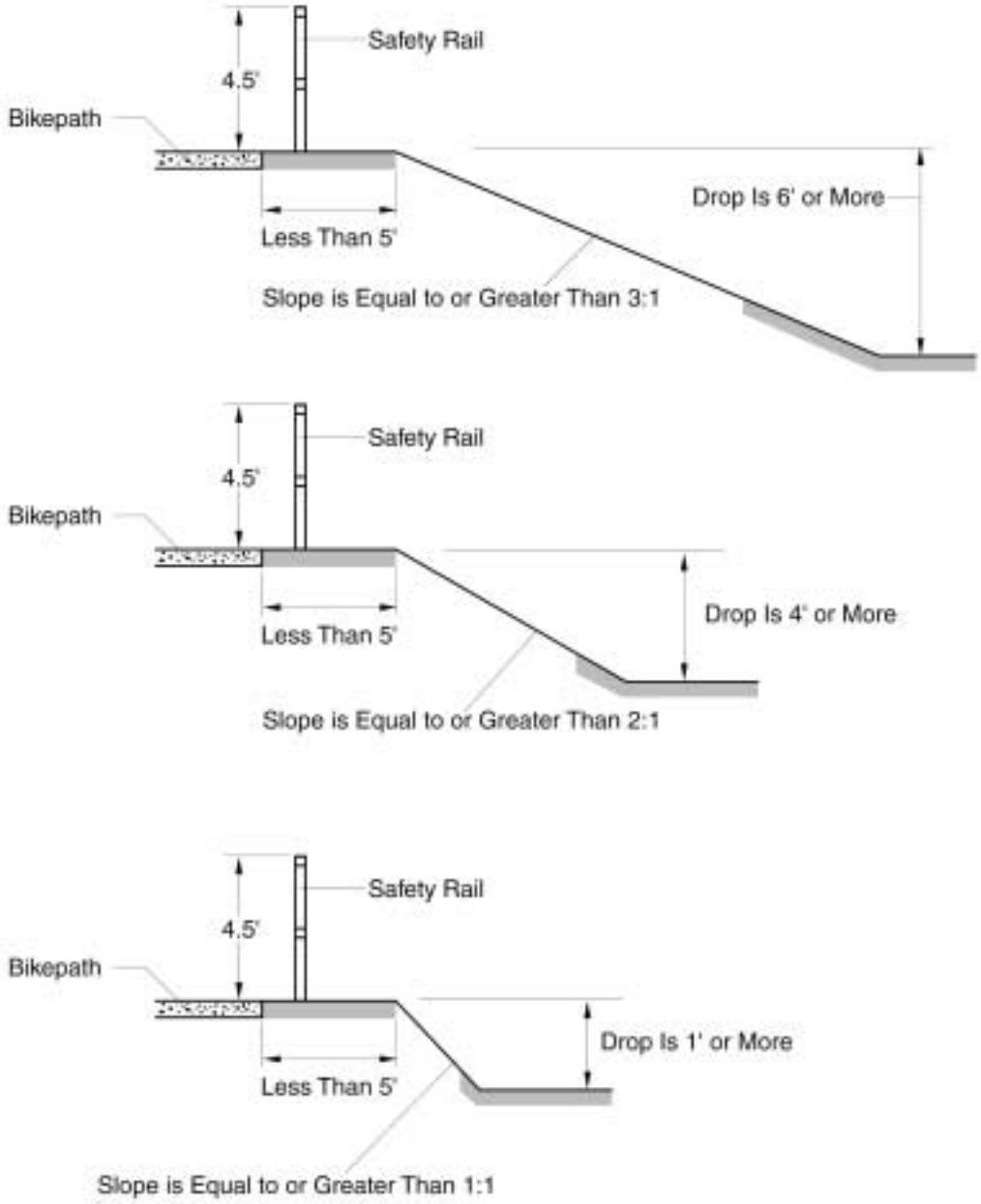
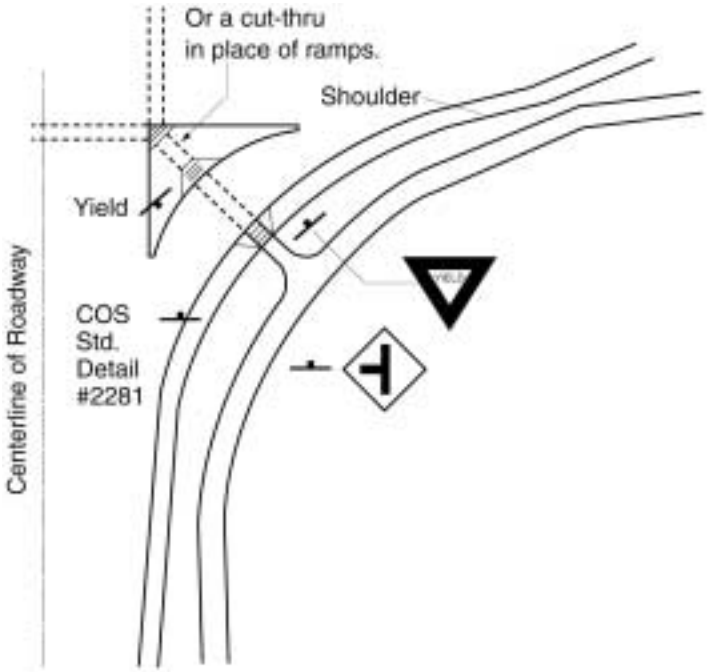
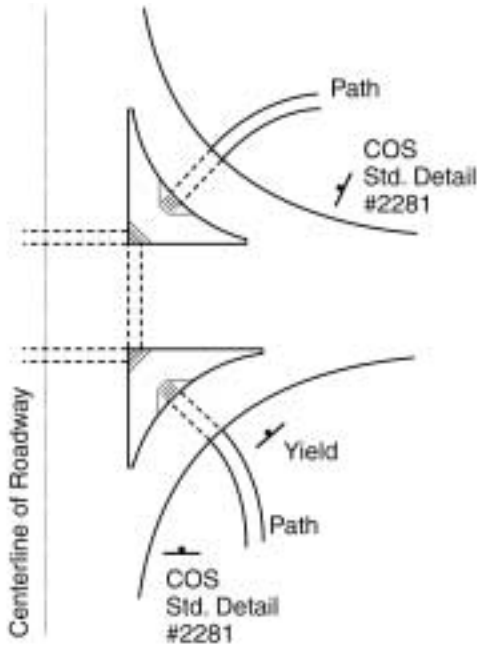
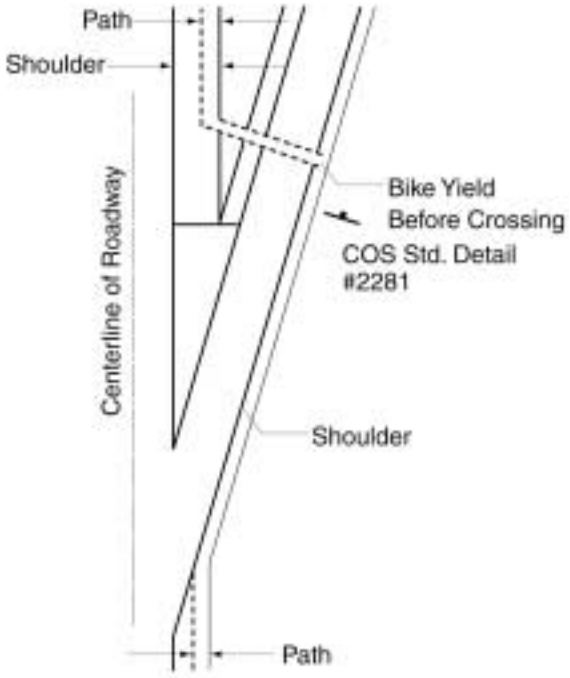


Figure 3.4-14
Multiuse Paths – Safety Rails Along Side Slopes



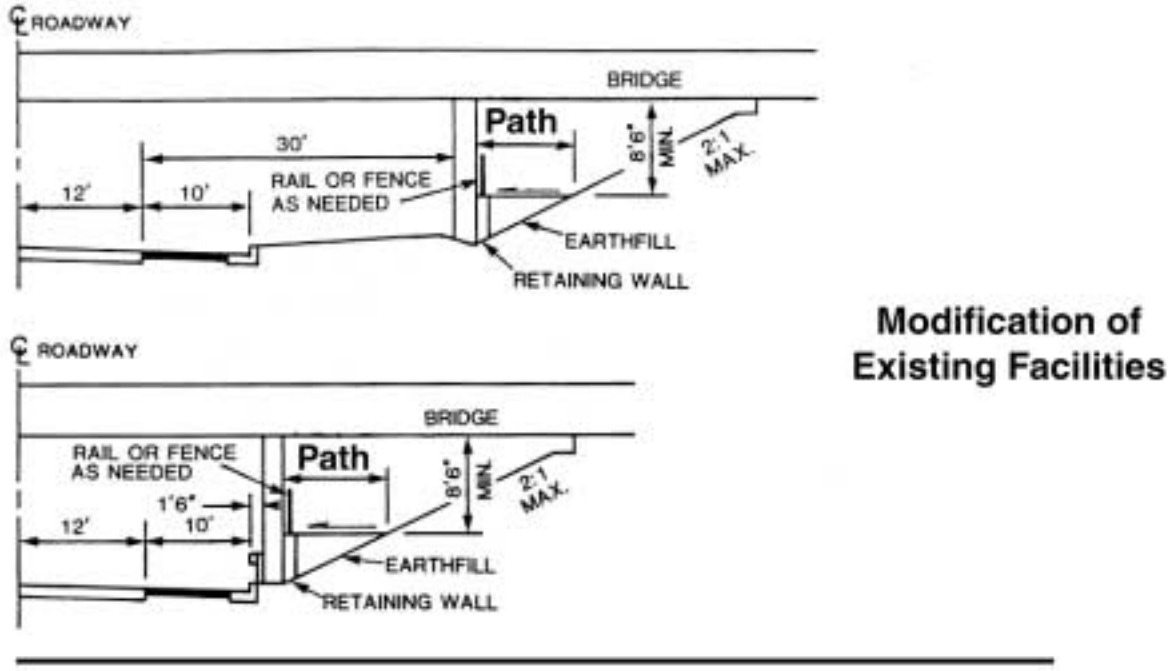


"Yield" signs or "Watch for Turning Vehicles" as appropriate. Ramps per Figure 3.4-12.

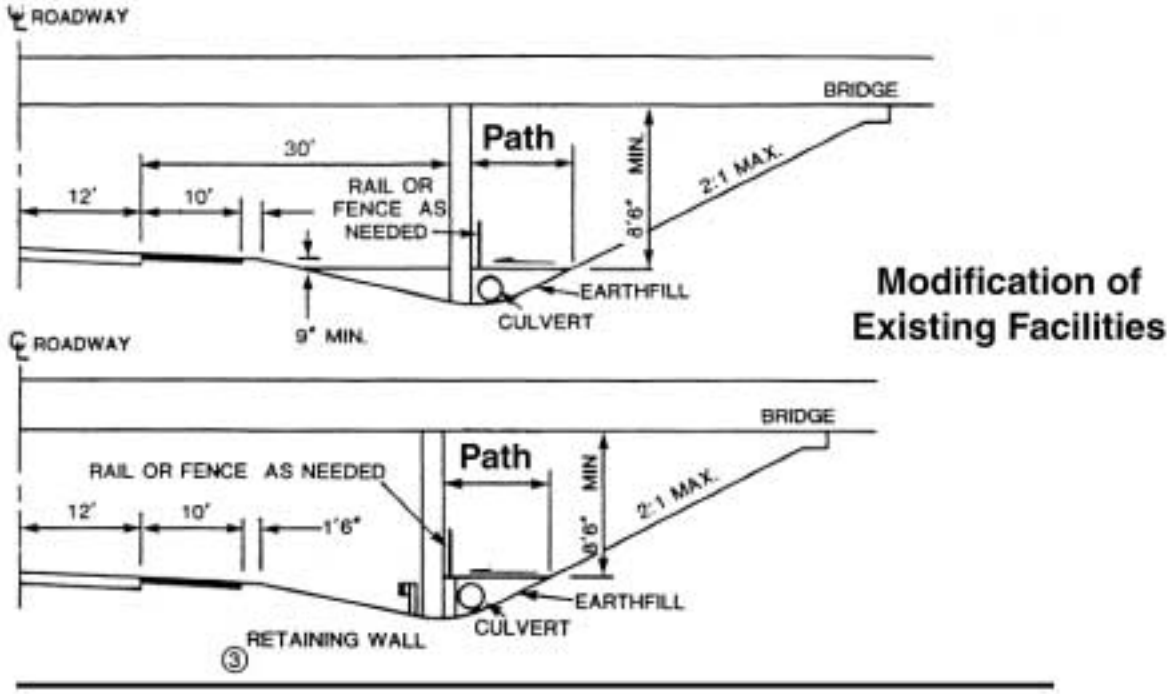


Note: Multiuse path is two-way.
all curb ramps need to be per Figure 3.4-12.
Perpendicular crossings are safest.

Figure 3.4-15
Options for Intersections Paths & Ramps



Modification of Existing Facilities



Modification of Existing Facilities

Figure 3.4-16

Under Bridge Structures – Multi-use Paths.

Section 3.5

FLEXIBLE PAVEMENT DESIGN
DESIGN STANDARDS AND POLICIES
REVISED DECEMBER 1999

CHAPTER 3
TRANSPORTATION

SECTION 3.5
FLEXIBLE PAVEMENT DESIGN

PAGE INDEX

FIGURE LIST

TABLE LIST

SECTION 3.5
FLEXIBLE PAVEMENT DESIGN

3-501 GENERAL INFORMATION

The purpose of this section is to describe the procedures to be used in the design of structural section of flexible pavements which are to be constructed in Scottsdale's public rights-of-way. Normally, this construction is done by developers of private property in fulfillment of the requirements for development stipulated by the City as a condition for authorization of the development.

A. Definitions

1. "Structural section" means the combination of an asphalt concrete surface course and a base course of either rock aggregate materials or asphalt concrete.

2. "Sub-grade" means native soil or fill material over which the structural section is to be placed.

3. "Asphalt concrete course" means the total depth of asphalt concrete which may be placed in one or more layers. An asphalt concrete course of three or four inches in depth will have two layers which are the asphalt concrete base course (ACBC) and the asphalt concrete surface course (ACSC).

4. "Rock aggregate base material" means the total depth of rock aggregate material which may be placed in one or two layers. If one layer is placed, it will be "Aggregate Base Course" (ABC) in accordance with Table 702 of the MAG Specifications. I f tow layers are placed, the top four inches must be ABC and the bottom layer may be ABC or "Select Material" in accordance with Table 702 of the MAG Specifications. For the sake of brevity, the rock aggregate base material is called the "base course" in this manual.

5. "Minor streets" is a phrase used in this section to refer to a group of streets classified as follows:

   - Local Residential Streets
   - Local Collector Streets

- Minor Collector Streets
- Local Commercial Streets
- Local Industrial Streets

6. "Major streets" is a phrase used in this section to refer to a group of streets classified as follows:

   - Major Collector Streets
   - Minor Arterial Streets
   - Major Arterial Streets

7. "MAG Specifications" are the Uniform Standard Specifications for Public Works Construction distributed by the Maricopa Association of Governments.

B. Method of Presentation of Design Standards and Policies.
The design standards and policies are presented in five parts. These five parts are described below.

1. The first part of the standards and policies, beginning with paragraph 3-502.A., concerns the design of asphalt concrete course.

2. The second part, beginning with paragraph 3-503.A., concerns the soil testing necessary for the design of the base course.

3. The third part, beginning with paragraph 3-504.A., concerns the design of the base course for minor streets.

4. The fourth part, beginning with paragraph 3-505.A., concerns the design of the base course for major streets.

5. The fifth part, beginning with paragraph 3-506.A., contains standards and policies which must be used to design the structural section for an expressway, and , when required by development stipulations, the structural section for certain major streets. These standards and policies may be used, at the option of the design engineer, to design the structural section for any major or minor street.

C. Street Classifications
It is essential to the design process to identify the classification of the street for which the design must be prepared. The basis for this classification is the Circulation Element of the General Plan for Scottsdale. Specific information on street classifications will be provided in the stipulations prepared by the City staff for each proposed development.

3-502 ASPHALT CONCRETE COURSE

A. Depth and Mix Requirements
The asphalt concrete portion of a flexible pavement shall have a minimum depth, number of courses, and mix design called for by street classification in Table 3.5-1 of this section. The mix design references are taken from the East Valley Asphalt Committee Design Standards and from Section 710 of the MAG Specifications and the City of Scottsdale Supplements to MAG. Mix designs and course thicknesses other than those specified in Table 3.5-1 may not be used unless approval to do so is provided by the Project Review Director or appointed designee. Minimum lift thicknesses are also outlined in Table 710-1

of the City of Scottsdale Supplements to MAG Specifications. The mix design and course thicknesses are to be clearly indicated on paving plans for public right-of-way improvements.

B. Use of Recycled Asphalt Concrete
Recycled asphalt concrete may be used in the construction of asphalt concrete pavements in the City of Scottsdale provided that the amount of recycled asphalt mix does not exceed 50% of the total mix required for the job. Recycled asphalt concrete mixes shall conform to City of Scottsdale specifications.

3-503 SOIL TESTING REQUIREMENTS

A. Subgrade Sampling Locations
There should be at least one sample taken at the depth of the planned subgrade for each type of soil found on the project site. There should also be at least one sample for each type of soil used as fill material on which a roadway is to be built. Samples should be taken in locations which the engineer responsible for the pavement design believes will provide an accurate representation of the subgrade which will lie beneath the pavement.

B. Types of Tests
The following tests are required for design procedures indicated and must be performed in accordance with ASTM procedures.

1. In order to use the base course design standards and policies for minor streets described under paragraph 3-504, the following tests are required:

    a. Sieve analysis of each sample is needed to determine the percent passing #200 sieve.

    b. Atterberg-Limits tests are needed for each sample. (The liquid limit and plastic limit to establish the plasticity index.)

2. In order to use the base course design procedures for major streets described under paragraph 3-505, or in order to use the structural section design procedures described under 3-506, R-value testing is required.

    R-value determination shall be made for exudation pressure of 3000psi. Each pavement thickness design must be based on the R-values determined by the tests, and for each length of pavement to be constructed with a constant thickness design, the lowest R-value within that length of pavement will be used. If the engineer elects to not run R-value tests on every subgrade sample, his design report must indicate the basis on which he selected the samples for the R-value tests.

3. Swelling tests are needed if the soil type indicates the presence of soils tending to swell significantly with added moisture.

C. Pavement Design Report
A pavement design report will be required for each development or project in which paving in the public right-of-way is to be done. This report must be submitted with the paving plans (or be a part of them) and it must describe the soil test results and design choices.

The report must include the following:

1. A map of the project area showing identification and location of each sample taken.

2. A description of the soil conditions.

3. A listing of the test results on each sample.

4. A statement of conclusions applicable to the pavement design.

3-504 BASE COURSE FOR MINOR STREETS

A. Base Course Design Charts, Figures 3.5-1 and 3.5-2

There are two design charts for the base courses of minor streets.

1. Figure 3.5-1 is a chart for the design of base courses for Local Residential Streets. The graphic information on this chart is the same as that shown on City of Phoenix Standard Detail P-1102.

2. Figure 3.5-2 is a chart for the design of base courses for:

   - Local Collector Streets
   - Minor Collector Streets
   - Local Commercial Streets
   - Local Industrial Streets

   The graphic information on this chart is the same as that shown on City of Phoenix Standard Detail P-1103.

B. Base Course Selection Procedure
A base course depth is selected for one of the street classifications mentioned above by finding a minimum base depth appropriate to the plasticity index and the percent passing the #200 sieve, which is data determined by the subgrade soils tests. For example: If a minor collector street is to be built on a subgrade soil which has a plasticity index of 12 and 60% of the soil passes the #200 sieve, the base course depth would be 9 inches, according to Figure 3.5-2. A local residential street on the same subgrade soil would have a base course of 7 inches, according to Figure 3.5-1. (Note that the top 4 inches of base course must be ABC.) By referring to Table 3.5-1, we find that at least 2-1/2" inches of 19mm asphalt concrete would be placed over either of these two bases.

C. Substitution of Asphalt Concrete for Aggregate Base Material
If the total structural section depth determined with the use of Table 3.5-1 and Figure 3.5-3 is undesirable, a deeper asphalt concrete section can be used in lieu of some or all of the aggregate base material at a rate of 1 inch of asphalt concrete for 3 inches of aggregate base material. For example: The design for a minor collector street described in the previous paragraph could be changed to a 3-1/2-inch deep asphalt concrete course over a 6-inch deep base course. This reduces the structural section from 11-1/2 inches to 9-1/2 inches.

3-505 BASE COURSE FOR MAJOR STREETS

A. Base Course Design Chart, Figure 3.5-3
The base course depths listed in Figure 3.5-3 are arranged in accordance with the street classifications and the R-values determined in the subgrade testing. The depths were determined by the use of the procedures for design of structural sections described under paragraph 3-506. For a given street classification, the street with the heaviest current and projected traffic loading was used to determine the range of base course depths for all streets of that classification; therefore, it can be said that the base course depths listed in this chart will provide conservative pavement designs.

B. Base Course Selection Procedure
A base course depth is selected for a major street by finding the depth in inches for the appropriate street classification under the proper R-value range. For example: If a major collector street is to be built on a subgrade which has an R-value of 38, according to the tests, the base course would be 12 inches deep. (Note that the top 4inches of the base course must be ABC.) By referring to Table 3.5-1, we find that at least 4-1/4 inches of asphalt concrete must be laid over the base course.

C. Substitution of Asphalt Concrete for Aggregate Base Material
If the total structural section depth determined with the use of Table 3.5-1 and Figure 3.5-3 is undesirable, a deeper asphalt concrete section can be used in lieu of some or all of the aggregate base material at the rate of 1 inch of asphalt concrete for 3 inches of aggregate base material. For example: The design described in the previous paragraph could be changed to a 5-1/4 inch deep asphalt concrete course over a 9-inch deep base course. This reduces the structural section from 16-1/4 inches to 14-1/4 inches.

3-506 MODIFIED AASHTO DESIGN PROCEDURES FOR EXPRESSWAYS AND SPECIAL REQUIREMENTS

A. Historical Background
The American Association of State Highway and Transportation Officials (AASHTO) published a guide for the design of pavement structures in 1961 and a revised guide in 1972. The Arizona Department of Transportation (ADOT) modified the procedures provided in the AASHTO design guide to meet requirements for the State of Arizona. The City of Phoenix uses the ADOT modified procedures and has selected certain design coefficients appropriate to the Phoenix metropolitan area. The City of Scottsdale will also use the ADOT-modified procedures with the City of Phoenix coefficients.

B. Assumptions
As mentioned in paragraph 3-506.A, ADOT uses its own adoption of the procedures outlined in the “AASHTO Guide for Design of Pavement Structures” published in 1961 and revised in 1972. The following assumptions must be made:

1. The soil support capacity of the subgrade soils can be predicted adequately by testing to determine R-values.

2. The R-values can be effectively related to a soil-bearing capacity rating scale called the soil support value (SS).

3. A suitable pavement depth design can be determined by a procedure that considers the soil support value in conjunction with projected traffics loading, environmental

conditions, and weighted structural values for the various components of the pavement structure.

C. Design Parameters
The following design parameters are used to design a pavement:

1. Soil Support Value
This is a value used to represent the bearing capacity of the subgrade soil. It is determined by a relationship established between its scale and the R-value scale. This relationship is not uniform throughout the country. ADOT has established the relationship shown in Table 3.5-2.

2. Serviceability Index
This index is a number that represents the surface condition of roadway in terms of ride-ability, cracking, patching, and rutting at some point in its design life. It is used in the design equation to represent the theoretical loss of serviceability over the 20-year design period. The Initial Serviceability Index is 5.0. The Terminal Serviceability Index varies, depending upon the level of service desired. Scottsdale uses a Terminal Serviceability Index of 2.5.

3. The Structural Number
This is an index number, derived from an analysis of traffic, subgrade soil conditions, and environmental conditions, that is used in conjunction with structural layer coefficients, which are related to the type of material to be used in each layer, to calculate the thickness of a flexible pavement structure consisting of various flexible layers. The following is the equation for the structural number developed from data accumulated by the AASHTO road

$$SN=-1[\{(10504)(Wt^{0.10684})(R^{0.10684})\}/\{(10^{0.039714(SS-3)})(10^{0.10684(Gt/B)}\}]$$

WHERE:
SN=Structural Number
WT=Total 18,000 pound, single-axle loads
R=Regional Factor=1.0
SS=Soil Support Value

$$B=0.40 + [(0.081*19^{3.23})/(SN+1)^{5.19}]$$

$$Gt=Log[(P_o-P_t)/(P_o-1.5)]$$

WHERE:
P_o=Initial Serviceability Index=5.0
P_t=Terminal Serviceability Index=2.5

Since “SN” appears on both sides of the equation, the solution can be most rapidly done by nomograph. Figure 3.5-4 is a nomograph developed by ADOT for this purpose, with a Terminal Serviceability Index of 2.5 and a Regional Factor of 1.0.

4. Projected Traffic Loading
This is an equivalent daily application of 18,000-pound single-axle loads. All vehicle use data during a 20-year period of time must be converted to equivalent 18K single-axle load applications to be used with Figure 3.5-4. The load applications can be expressed either as a daily 20-year mean or as the total of the load applications

applied over a 20-year mean times 365 times 20. The data required consists of the following:

- Current traffic ADT (traffic flowing in both directions)
- The 20th year ADT (traffic flowing in both directions)
- Percentage of each type of vehicle classification.

The steps described below will provide the vehicle load information which is used in Figure 3.5-4.

a. Determine the average of the current ADT and the terminal year ADT and divide by 2 to arrive at an average ADT in one direction. Express this quantity in terms of thousands of vehicles. For example:

   Current ADT = 19,500 vehicles
   Terminal ADT = 33,000 vehicles

   [(19.5+33.0)/2](0.5)=13.125

b. Calculate the 18K equivalent single-axle load applications using the vehicle distribution percentages determined by a traffic survey and the 18K single-axle load for each type of vehicle listed in Table 3.5-3.

   For example: If commercial vehicles make up 23.9% of all vehicles using the roadway under consideration, heavy four-tire trucks (Type 2S) make up 18.3% of all commercial vehicles, and the Type 2S 18K single-axle equivalent per 1,000 vehicles is 5.8, as indicated in Table 3.5-3, then the load application for this type of vehicle per 1,000 vehicles is:

   (0.239)(0.183)(5.8) = 0.254

c. The sum of all such loads is the equivalent 18K single-axle load per 1,000 vehicles traveling the road. This sum must be multiplied by the average ADT for traffic in one direction calculated in step #a above. The result of this multiplication is the number of daily, 20-year mean, equivalent 18K single-axle loads produced by traffic moving in one direction.

d. If the street has more than one lane in each direction, then the load calculated in subparagraph c above could be multiplied by the following appropriate factor to calculate the design lane load:

   1) If the street is to have two lanes in each direction, multiply the number of equivalent 18K single-axle loads by 0.90 to arrive at a design lane equivalent 18K single-axle loading.

   2) If the street is to have three lanes in each direction, multiply the number of equivalent 18 K single-axle loads by 0.70 to arrive at a design lane equivalent 18K single-axle loading.

e. The calculations described above provide the number of daily equivalent 18K single-axle (20-year mean) loads to be used in Figure 3.5-4.

f. Figure 3.5-7 is an example worksheet illustrating steps a. through e. above. Figure 3.5-6 is a blank worksheet for the design engineer's use.

5. Regional Factor
This factor is used to adjust the Structural Number for climatic and environmental conditions different from those of the AASHTO road test site. The Regional Factor to be used for Scottsdale is 1.0. Since the Regional Factor we are using is 1.0, the nomograph shown on Figure 3.5-4 is an abbreviated form of the nomograph prepared by ADOT. No adjustment of the Structural Number for regional conditions is needed.

6. Structural Coefficients
The components of the pavement structure are assigned structural coefficients to be used with the structural number in developing the design of pavement section. The coefficients shown below were developed by the City of Phoenix from experience, tests, and correlation with information in ADOT design manuals and MAG Specifications.

Local Pavement Component	ADOT Range	Local Coefficient
Asphaltic Concrete (plant mix)	0.34 to 0.46	0.39
Bituminous Treated Base	0.30 to 0.35	0.31
Cement Treated Base*	0.15 to 0.29	0.23
Aggregate Base	0.08 to 0.14	0.12
Select Material	0.05 to 0.12	0.11

*The Cement Treated Base coefficient is for plant mix. If a road mix is used, the percentage of cement to be used must be increased by 0.5%.

D. The Design Procedure

1. Determine the Structural Number (SN) for the pavement to be designed. The following is the method to be used:

a. R-values must be determined by testing and an R-value must be selected for the design. Using Table 3.5-2, select the Soil Support Value (SS) that corresponds to the selected R-value.

b. Calculate the equivalent 18K single-axle load application for the length of the street for which the pavement design is required. The procedure for this calculation is described in paragraphs 3.506.C.4.a. through f. above.

c. Using the Soil Support Value obtained in step #a above, plot that value on the Soil Support Value Scale in Figure 3.5-4.

d. Using the equivalent 18K single-axle, 20-year load total or the daily, 20-year mean traffic loading data obtained in step b above, plot the traffic load on the appropriate scale on Figure 3.5-4.

e. Draw a straight line form the point plotted on the Soil Support Value Scale of Figure 3.5-4 through the point plotted on the equivalent 18K single-axle load scale until it intersects the Structural Number Scale. The Structural Number which can be read at its intersection is the Structural Number to be used for the pavement design.

2. Using the Structural Number, calculate the thickness of the structural components with the following equation:

   C1D1+C2D2+C3D3…CNDN = SN

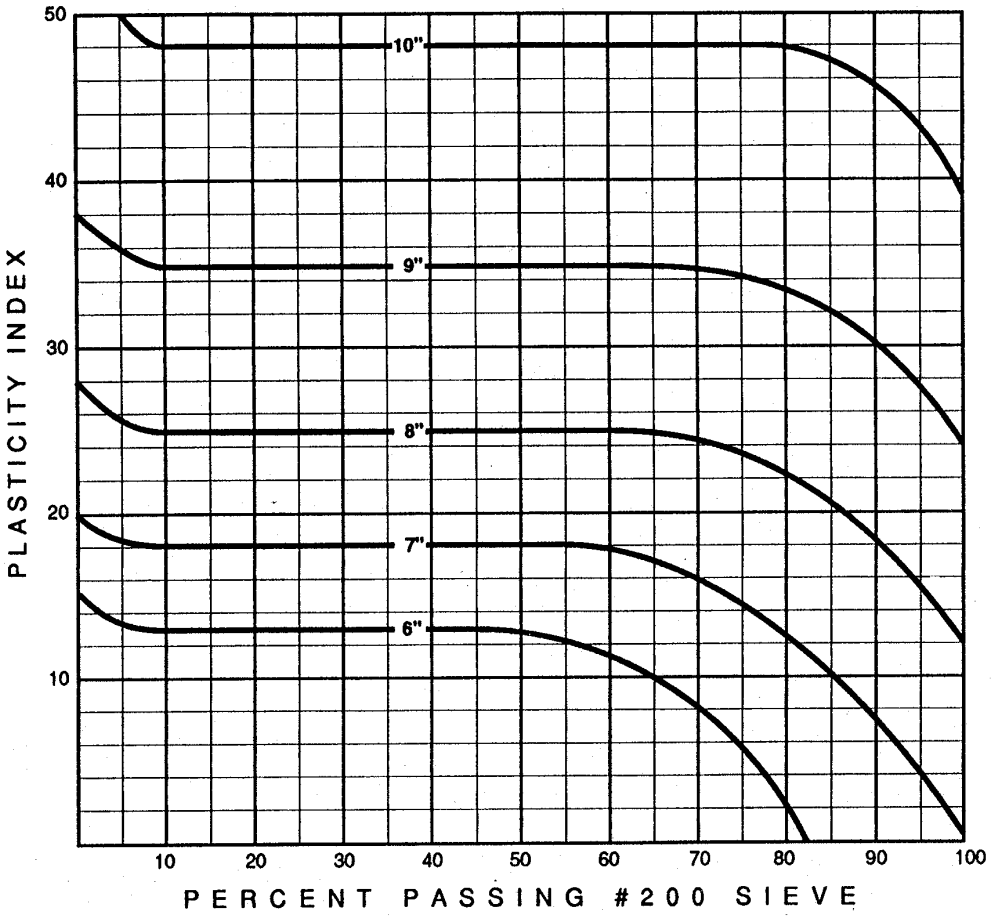
   WHERE:
   C1,C2,C3…=Structural Coefficient from paragraph 3-506.C.6. above.
   D1,D2,D3…=Thickness of Component

   It is necessary to assume the depth of certain elements so that the remaining depths can be calculated. For example: The Structural Number is determined to be 3.2 from Figure 3.5-6 for given soil support and traffic loading conditions, and it has been decided that the asphaltic concrete will be 5" thick and the ABC will be 4" thick. We must determine the thickness of the select material. From paragraph 3-506.C.6. above, we find that the structural coefficients are 0.39 for the asphaltic concrete, 0.12 for the ABC and 0.11 for the select material. The calculation of the thickness of the select material (SM) is accomplished in the following manner:

   C1D1+C2D2+C3D3=SN

   (0.39)(5)+(0.12)(4)+(0.11)(SM)=3.2

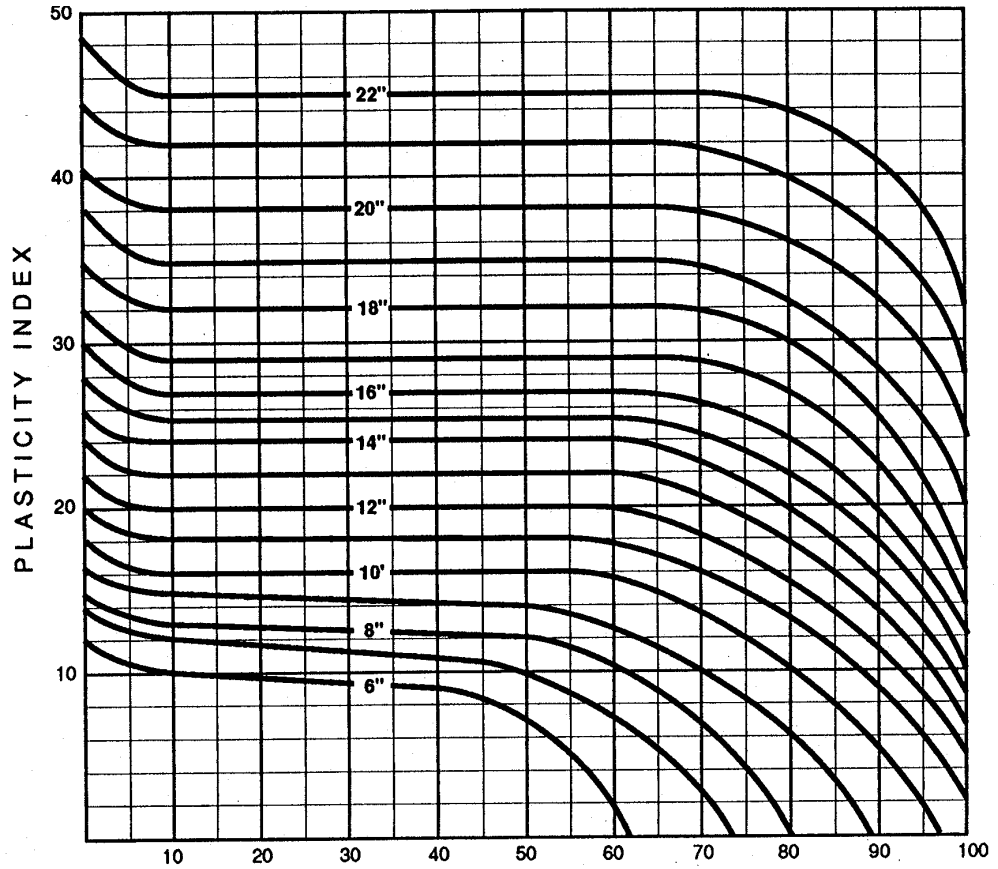
   Solving for SM and rounding off to the nearest inch: SM=7.0 inches



Note: The top 4" of the base course shall be ABC and the balance shall be ABC or select material.

FIGURE 3.5-1

Minimum Depth of the Base Course for Local Residential Streets



Note: The top 4" of the base course shall be ABC and the balance shall be ABC or select material.

FIGURE 3.5-2

Minimum Depth of the Base Course for Local Collector, Minor Collector, Local Commercial, and Local Industrial Streets

Street Classification \ R-Values	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50	50+
Major Collector	26	24	22	20	18	16	14	12	11	10	9
Minor Arterial Major Arterial	29	27	25	23	20	18	16	14	12	10	9

Note: The top four inches of the base course must be ABC. The remaining depth may be either ABC or select material.

FIGURE 3.5-3

Minimum Depth of Base Course in Inches by Street Classification and R-Value

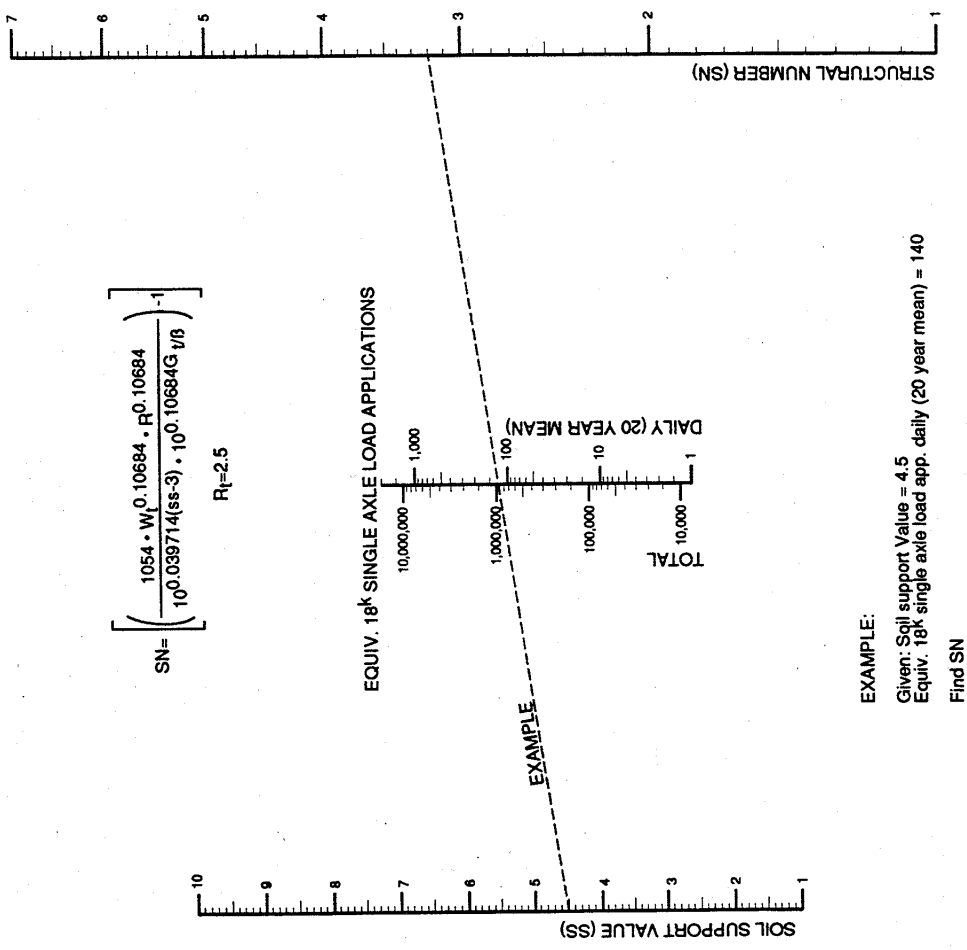


FIGURE 3.5-4

Design Chart - Flexible Pavements, 20 Year Traffic Analysis

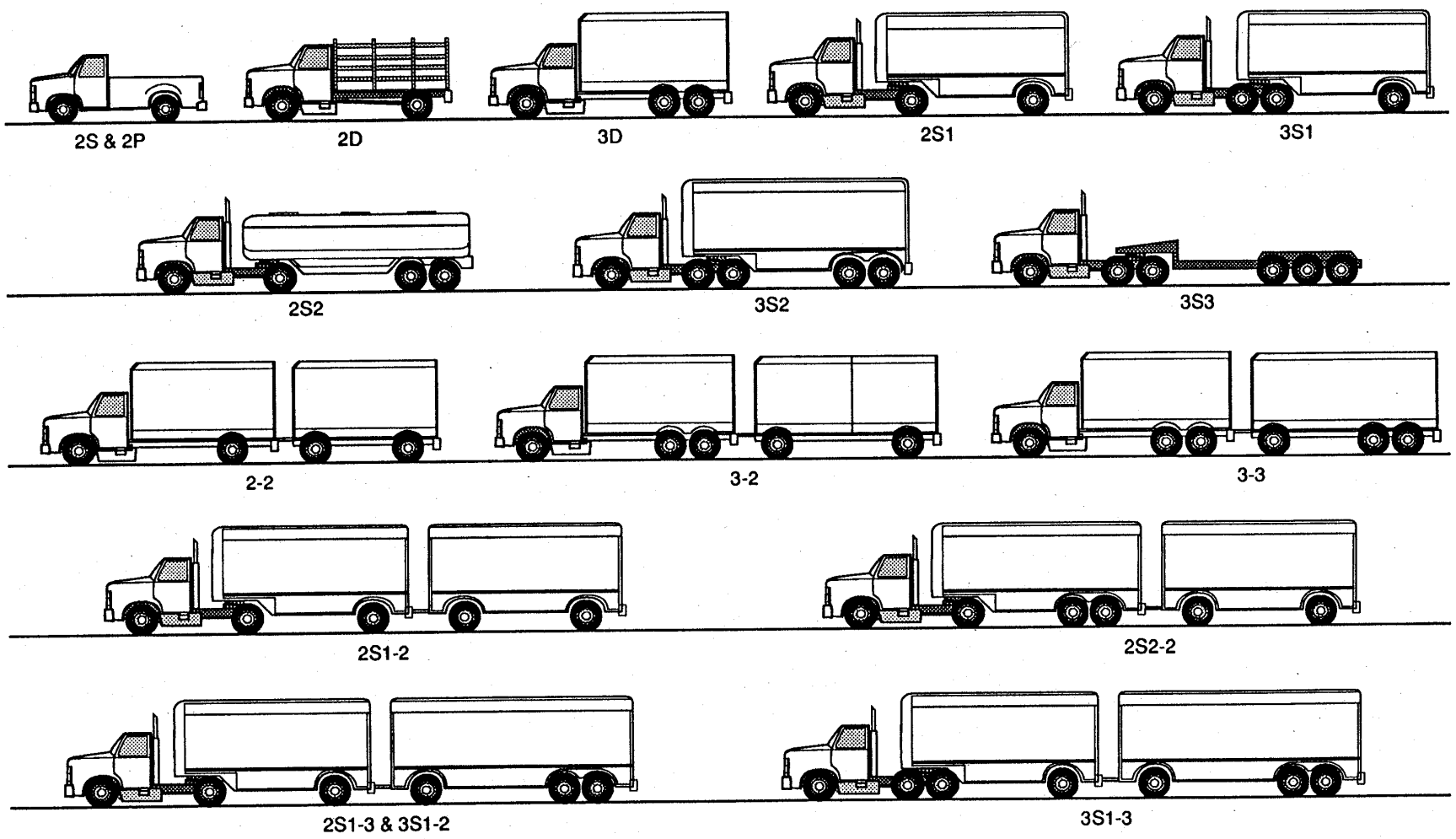


FIGURE 3.5-5

Illustration of Commercial Vehicle Types

TRAFFIC LOADING CALCULATION SHEET

DATE:

STREET NAME AND LOCATION:

STREET TYPE:	CURRENT YEAR AND A.D.T.:	20TH YEAR AND A.D.T.:

CALCULATION OF MEAN, ONE-WAY TRAFFIC (THOUSANDS OF VEHICLES PER DAY):

$$\frac{\qquad\qquad}{\qquad\qquad}$$

NOTATION FOR TYPE OF VEHICLE:	PROPORTION BY TYPE OF VEHICLE		18k LOAD BY 1000 VEHICLE	EQUIV. 18k LOAD BY VEHICLE DISTRIBUTION
	PROPORTION THAT ARE COMMERCIAL VEHICLES	PROPORTION BY TYPE OF COMMERCIAL VEHICLE		
		TOTAL OF EQUIVALENT 18^k LOADS PER 1000 VEHICLES:		

CALCULATION OF DAILY, 20 YEAR MEAN, EQUIV. 18^k SIGNLE AXLE LOAD APPLICATIONS FOR ONE WAY TRAFFIC:

CALCULATION OF DESIGN LANE LOADING:

FIGURE 3.5-6

Traffic Loading Calculation Sheet

TRAFFIC LOADING CALCULATION SHEET

DATE:

STREET NAME AND LOCATION:

Shea Blvd., 64th St. to Scottsdale Rd.

STREET TYPE:	CURRENT YEAR AND A.D.T.:	20TH YEAR AND A.D.T.:
Major Arterial	1990-19,500 Veh.	2010-33,000 Veh.

CALCULATION OF MEAN, ONE-WAY TRAFFIC (THOUSANDS OF VEHICLES PER DAY):

$$\frac{19.5 + 33.0}{2} \cdot 1/2 = 13.128$$

NOTATION FOR TYPE OF VEHICLE:	PROPORTION BY TYPE OF VEHICLE		18k LOAD BY 1000 VEHICLE	EQUIV. 18k LOAD BY VEHICLE DISTRIBUTION
C	0.761		0.8	0.609
B	0.0		250.0	0
	PROPORTION THAT ARE COMMERCIAL VEHICLES	PROPORTION BY TYPE OF COMMERCIAL VEHICLE		
2P	0.239	0.599	1.2	0.172
2S	0.239	0.183	5.8	0.254
2D	0.239	0.108	163.2	4.213
3D	0.239	0.067	598.7	9.587
2S1	0.239	0.005	408.2	0.488
2S2	0.239	0.008	956.5	1.829
3S2	0.239	0.005	514.3	0.615
2-2	0.239	0.006	304.3	0.436
3-2	0.239	0.006	936.8	1.343
3-3	0.239	0.003	936.8	0.672
2S1-2	0.239	0.007	846.7	1.417
3S1-2	0.239	0.003	958.0	0.687
			TOTAL OF EQUIVALENT 18k LOADS PER 1000 VEHICLES:	22.322

CALCULATION OF DAILY, 20 YEAR MEAN, EQUIV. 18k SIGNLE AXLE LOAD APPLICATIONS FOR ONE WAY TRAFFIC:

$$13.125 \cdot 22.322 = 292.976$$

CALCULATION OF DESIGN LANE LOADING:

$$0.70 \cdot 292.976 = 205 \text{ (use 200)}$$

FIGURE 3.5-7

Illustrated Traffic Loading Calculation Sheet

Street Classification (Ref. Development Stipulations)	Depth (Inches)	Type of Mix (Table 710-1)	
		Asphalt Base Course	Asphalt Surface Course
Local Residential Local Collector Minor Collector Local Commercial Local Industrial	2-1/2"	N/A	2-1/2" of 19mm
Major Collector	4-1/4"	2-1/2" of 19mm	1-3/4" of 12.5mm
Minor Arterial Major Arterial	5-1/2"	3" of 25mm	2-1/2" of 19mm

TABLE 3.5-1

Minimum Asphalt Concrete Depth Requirements by Classification of Street
Reference Section 710 of the MAG Specifications and City of Scottsdale Supplemements

R-Value	Soil Support Value
0	1.750
1	1.844
2	1.938
3	2.032
4	2.126
5	2.220
6	2.314
7	2.408
8	2.502
9	2.596
10	2.690
11	2.784
12	2.878
13	2.972
14	3.066
15	3.160
16	3.254
17	3.348
18	3.442
19	3.536
20	3.630
21	3.724
22	3.818
23	3.912
24	4.006
25	4.100
26	4.194
27	4.288
28	4.382

R-Value	Soil Support Value
29	4.476
30	4.570
31	4.664
32	4.758
33	4.852
34	4.946
35	5.040
36	5.134
37	5.228
38	5.322
39	5.416
40	5.510
41	5.604
42	5.698
43	5.792
44	5.886
45	5.980
46	6.074
47	6.168
48	6.262
49	6.356
50	6.450
51	6.544
52	6.638
53	6.732
54	6.826
55	6.920
56	7.014
57	7.108
58	7.202

R-Value	Soil Support Value
59	7.296
60	7.390
61	7.484
62	7.578
63	7.672
64	7.766
65	7.860
66	7.954
67	8.048
68	8.142
69	8.236
70	8.330
71	8.424
72	8.518
73	8.612
74	8.706
75	8.800
76	8.894
77	8.988
78	9.082
79	9.176
80	9.270
81	9.364
82	9.458
83	9.552
84	9.646
85	9.740
86	9.834
87	9.928
88+	10.000

This table is based on the equation: SS = 0.094R + 1.75

TABLE 3.5-2

ADOT Material Services R-Value and Soil Support Value Relationships

Notation	Type of Vehicle	18k Single-Axle Equiv. per 1000 Veh.
C	Passenger cars	0.8
B	Busses	250.0
2P	Light 4-tire trucks	1.2
2S	Heavy 4-tire trucks	5.8
2D	2-axle, 6-tire trucks	163.2
3D	3-axle trucks	598.7
2S1	2-axle tractor, 1-axle semi-trailer	408.2
2S2	2-axle tractor, 2-axle semi-trailer	956.5
3S2	3-axle tractor, 2-axle semi-trailer	514.3
2-2	2-axle truck, 2-axle semi-trailer	304.3
3-2	3-axle truck, 2-axle full trailer	936.8
3-3	3-axle truck, 3-axle full trailer	936.8
2S1-2	2-axle tractor, 1-axle semi-trailer, 2-axle full trailer	846.7
3S1-2	3-axle tractor, 1-axle semi-trailer, 2-axle full trailer	958.0

TABLE 3.5-3

Tabulation of 18_k Single-Axle Equivalent Loads by Type of Vehicle

Source: ADOT weighted arithmetic mean of 197[illegible]75, and 1976 loadometer data for urban roads.

Section 3.6

Traffic Signs and Markings

Design Standards and Policies
Revised December 1999

Chapter 3
Transportation

SECTION 3.6
TRAFFIC SIGNS AND MARKINGS

PAGE INDEX

Figures

SECTION 3.6
TRAFFIC SIGNS AND MARKINGS

3-601 INTRODUCTION AND DEFINITIONS

This booklet has been prepared to present the criteria and procedures to be utilized by consultants when performing traffic signing and pavement markings design work in and for the city of Scottsdale.

The following abbreviations apply herein:

AASHTO - American Association of State Highway and Transportation Officials

ADOT - State of Arizona Department of Transportation

' AHD - Arizona Department of Transportation Highways Division

City or COS - City of Scottsdale

ITE - Institute of Transportation Engineers

MAG - Maricopa Association of Governments

MUTCD - Manual on Uniform Traffic Control Devices

CAL-TRANS - State of California Department of Transportation

3-602 DESIGN SPECIFICATIONS

The following publications or their current revisions are to be used in conjunction with the design criteria in this booklet when performing traffic signs and markings design work in the City of Scottsdale.

"MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS" - U.S. Department of Transportation, Federal Highway Administration, Current Revision.

"SIGNING AND MARKING" - Standard Drawings, ADOT.

"TRAFFIC CONTROL MANUAL FOR HIGHWAY CONSTRUCTION AND MAINTENANCE" - ADOT 1989.

"MANUAL OF SIGNS APPROVED FOR USE ON STATE HIGHWAY SYSTEM" - ADOT.

"POLICIES, GUIDE AND PROCEDURE MANUAL" - ADOT.

"SUPPLEMENT TO MAG UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" - City of Scottsdale.

"SUPPLEMENTAL STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION" - City of Scottsdale.

"UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION" - MAG.

"UNIFORM STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION" - MAG.

“TRAFFIC BARRICADE MANUAL” - City of Phoenix.

3-602 DESIGN STANDARDS

A. General

1. Design shall be in accordance with the MUTCD unless modified by the City as noted herein.

B. Signing

1. All sign posts are to be telespar per COS MAG Supplemental Specification Section 402.

2. Utilize street poles for sign mounting whenever possible.

3. "No Parking" signs shall be R8-3a (12" x 18") modified with a lower arrow plaque. They shall be placed approximately 350-400 feet apart on all arterial and collector street classification 45 degrees to the curb.

4. Speed limit signs (R2-1) are to be installed at 4 per side per mile.

5. Stop signs (R1-1) are to be 30" x 30" minimum size.

6. Street name signs in subdivisions must conform with City colors and standards.

7. Advance street name signs are to be installed at a height of 4 feet to the bottom of sign and placed so that they will not be obstructed by vegetation. Signs shall be installed in medians whenever possible.

8. Median nose signing is to be installed per COS Supplemental Detail No. 2133 as follows:

   a. Type "A" is to be installed at signalized intersections and the first median nose in a succession of medians.

   b. Type "B" is to be used at all other median nose locations.

C. Striping

1. All permanent pavement striping (lines and crosswalks) shall be 60 mil. hot-sprayed thermoplastic. Temporary pavement markings shall be reflectorized traffic paint.

2. All median noses shall be painted per COS Supplemental Detail No. 2225-1, 2225-2, and 2226.

3. COS striping and marking standards are shown in Figures 3.6-1 through 3.6-4.

3-603 STANDARD PLAN LAYOUT

A. General

1. Signing and pavement marking design shall be shown in the same plan view.

2. Plan sheets are to be complete and to scale 1" = 40' unless otherwise approved by the City Transportation Division.

3. Entire length of project is to be shown in plan view. "Typical Sections" representative of striping and/or signing will not be accepted.

4. Signing and pavement marking plans shall include all existing signing and pavement markings for a minimum of 300 feet past the limits of construction and shall include adequate transitions and tapers to maintain traffic at the design speed.

5. The City requires a specific title and signature block to be placed in the lower right corner of each sheet (see Traffic Signal Design, Section 3.2, Figure 3.2-3). The Consultant's title block shall be placed adjacent to the City block.

6. Right-of-way lines shall be stationed and clearly identified.

B. Standard Plan Sheet Notes
These notes along with any additional project specific notes shall be placed on the lead signing and pavement marking plan sheet.

1. All pavement markings, signing, and construction shall conform to Arizona Department of Transportation standard drawings and specifications unless otherwise specified in the "Manual on Uniform Traffic control Devices," latest edition.

2. Traffic control shall conform to the City of Phoenix "Traffic Barricade Manual" and/or as directed by the City Public Works Inspector.

3. Signs shall be installed on telespar posts per COS Standard Detail No. 2131.

4. All signs that are removed and not reinstalled shall be salvaged and delivered to the city of Scottsdale Corporation Yard at 9191 E. San Salvador (Scottsdale).

5. All lane striping, crosswalks, and chevrons shall be 0.060" (60 mil) hot-sprayed thermoplastic, unless noted otherwise on the plans.

6. All pavement symbols, arrows and legends shall be Type I pre-formed pavement markings.

7. Raised pavement markers (RPM's) shall be used on all striped streets. (RPM's) shall be installed per COS Standard Detail No. 2132 and ADOT Standard Drawing 4-M-2.02, with a City approved bituminous adhesive.

8. All existing pavement markings which conflict with proposed markings shall be removed by sandblasting, hydroblasting, or grinding prior to the installation of new pavement markings. Removals shall be to the satisfaction of the City Inspector.

9. "No Parking" signs (R8-3a) with double arrow (or double arrow plaque) shall be installed or reinstalled approximately every 350-400 feet along the length of the project, approximately 5 feet from the back of curb, angled 45 degrees from the roadway. Band to street light poles when feasible.

C. Signing

1. All signs shall be graphically depicted in the direction of travel.

2. All signs shall be stationed and referenced to the appropriate MUTCD sign designation with size noted.

3. New and existing signs shall be visible to traffic for a value equal to 4 times (4x) the Existing or proposed posted speed limit to provide adequate approach visibility. Existing or proposed roadway improvements, vegetation, or structures shall not block traffic sign visibility.

4. Existing signs will be identified to either remain, be removed, or be relocated consistent with note 2 above.

5. Consultant shall field verify all existing advance or approach signing applicable to the project. Reference signs on plan sheet including location or station and note status of sign.

D. Striping

1. Existing striping shall be fully shown (as screened lines or lightly inked pen lines), identified by type and width, and completely dimensioned across roadway.

2. Raised pavement markers shall be graphically shown in plan view and referenced by construction notation.

3. All new striping shall be clearly identified noting color and line width.

4. Striping to be removed shall identified on the plans.

5. All striping shall be fully dimensioned across roadway and tied to a construction centerline or monument line at each side of an intersection.

6. All pavement arrows, legends, crosswalks, etc., shall be located by station or dimension lines.

Skip Lines

4" wide lines, ten feet long, gaps thirty feet.

Short Skip Lines

4" wide white lines, three feet long, gaps ten feet.

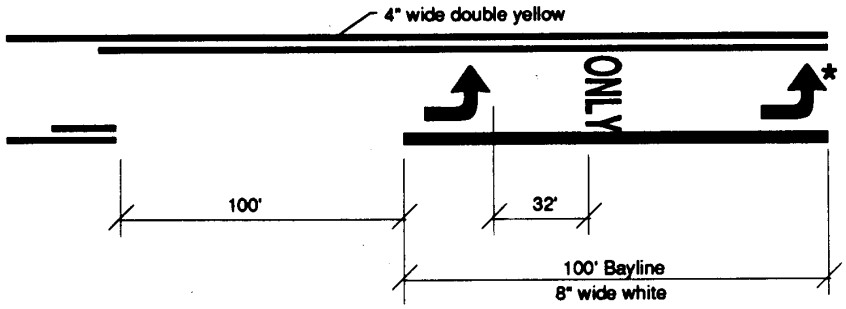
Edge Lines:

4" wide white off the edge of pavement where curbs are omitted.
8" wide white where asphalt tapers for a lane drop, etc.

Two Way Left Turn Lanes

All lines 4" wide yellow, skip lines to follow typical skip line dimensions.

Left Turn Bay (used at signalized intersections and major cross streets)



Arrow and "ONLY" to be painted in left turn bays which do not align with opposing left turn bays.
*If bay line is longer than 150', a second arrow is placed at the top of the bay.

FIGURE 3.6-1
Standard Striping Layout

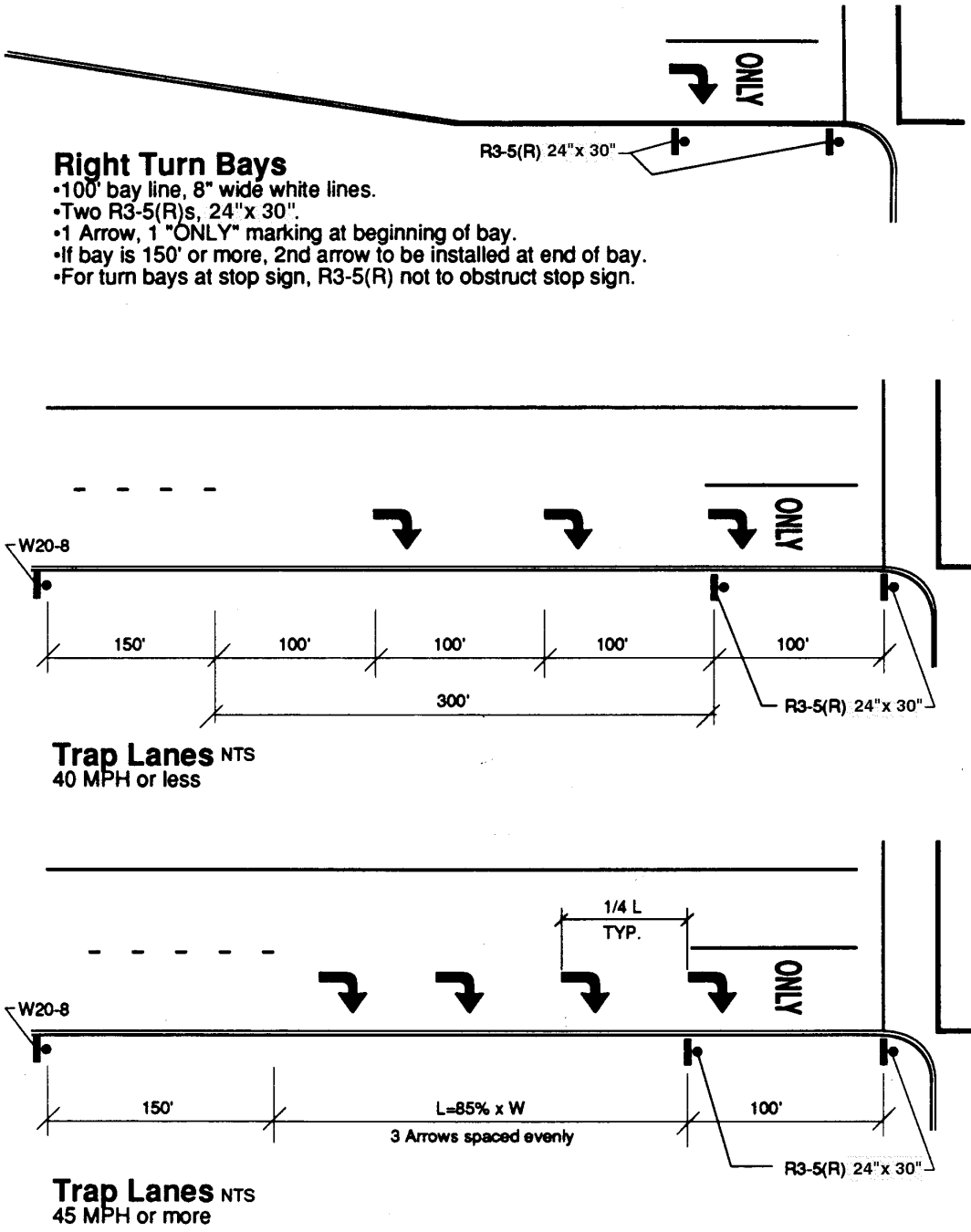
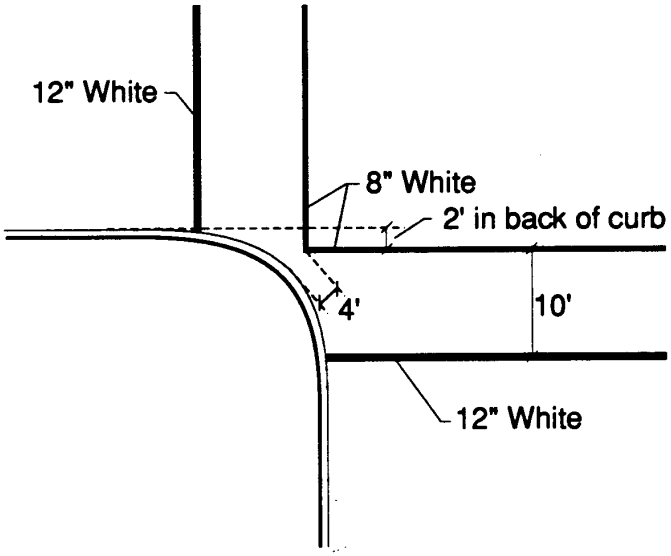
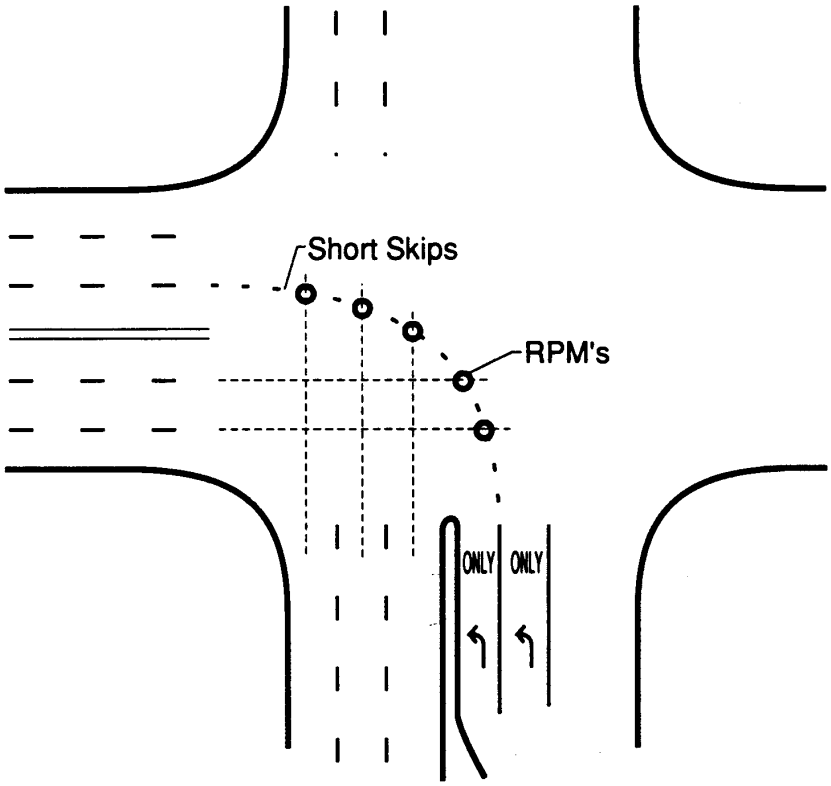


FIGURE 3.6-2
Standard Turning Bay and Trap Lane Layout



Cross Walk Painting
Cross walks are to be painted at signalized intersections only unless otherwise specified.

FIGURE 3.6-3
Standard Crosswalk Layout



Dual Left Turn Movement

- Paint short skips through intersection.
- Space Raised pavement Markers to align with lane lines or centered in lanes (as shown).

FIGURE 3.6-4

Dual Left Turn Striping Layout